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J. M. WAKEMAN, - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 936 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. SHAW, Manager.
Hastings House, Norfolk St., Strand, London, England.
PARIS, - - - - - - - - - Electricity Building, Paris Exposition.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. LALTAVALL, - - - - - - - - - - - Associate Editor.
CARL HERING, - - - - - - - - - - - - Special Contributor.

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SEVEN THOUSAND PARIS EXHIBITORS.

The carefully prepared article on the nature and features of the Paris Exposition appearing in the present issue will be of service to those intending to visit the Exposition and of interest to every one whose affairs touch the sciences and arts of electricity and their allied mechanical applications. It is evident that a show of great importance and beauty has once more been presented on the banks of the Seine to the public of the world; and that, although, like every other exposition of international character it is not ready at the moment of inauguration, it will be in excellent shape for inspection by the time most prospective visitors arrive on the grounds.

To a large and even predominating extent the Paris Exposition is an object lesson in electricity, whose utilities there, as our article shows, are all-pervading in light, traction, motive power, interior transportation, spectacular effects and the swift interchange of communication. It is fit and proper that the last great exhibition of the century should thus exemplify the triumphs of the most subtle agent man has yet subdued to his will. It is said that one of the questions very much in the air at Paris, and freely debated, is whether there will be any more exhibitions of the international type on the colossa scale. Electricity and steam having done so much to bring people together and to scatter products and information, the necessity that existed in the earlier years of the Nineteenth Century for these World Fairs has become greatly diminished. And yet, on the other hand, the freedom of movement acquired and the activity of thought engendered have, by way of balance, created a taste for such opportunities of comparison and conference that may yield spectacles of this nature in the next hundred years far finer than any witnessed during the last.

Seven thousand American exhibitors have gone to Paris, spending at least a million dollars to supplement that amount appropriated by Congress. The one desire on the part of each exhibitor is to make new friends, new connections, new customers, and, in a great many cases, the hope will be abundantly realized. At this moment we know of one enterprising concern whose large exhibition plant has virtually been sold three times over before it started up, and who is now negotiating on a lot of other foreign work. Even the exhibitor who now does not accomplish much will have had his wits sharpened as an exporter and will have found that as he meets the market by adaptation to its needs it is waiting and anxious to buy from him. The point for exhibitors and non-exhibitors alike to remember, is that in a few months the great Paris Exposition will be a thing of the past, but that the opportunities for trade will be larger than ever. American exports continue to demonstrate a power of expansion that is most encouraging, but the trade is for those who go after it. With this conviction, the conductors of this journal have sought to lay emphasis on the importance of export trade and by journalistic effort have aimed to give the movement proper direction and additional impetus. The facilities created by its special staff at Paris are at the service of all visitors and inquirers, but it is to be borne in mind that when the Paris Exposition ceases, the export mission of such papers as this will have but barely begun. As was said recently by a well-known American engineer now on the other side of the Atlantic: "Europe is virgin soil for development on American lines in apparatus and practice," and one has but to observe the changes now in progress there to realize that, to paraphrase the famous remark of Emerson, Europe is an-

other name for opportunity. What is true there, is, however, even more so of Asia and Africa, in all parts of which the warmest appreciation is extended to American apparatus of all kinds. To cover such an area with "drummers," to put exhibition plants all over it, to depend on the effect of what may be done in the short spell at Paris, is neither feasible nor wise. Our readers know that, as American consuls continually say the best medium for opening up and cultivating such markets is the persistent use of the periodical press, itself becoming now a consular commercial service of no mean order as supplementing and enlarging the work of our national agents abroad.

NATIONAL STANDARDIZATION BUREAU.

A measure now before Congress of much importance to the electrical industry has for an object the extension of the present work of the United States Office of Standard Weights and Measures to cover a very important field, which hitherto has been neglected in this country. The measure proposes to merge the office into a National Standardization Bureau, under the control of the Secretary of the Treasury, and besides the custody of standards, its work will include the comparison with government standards, of standards used in engineering, manufacturing, commerce, scientific investigation and educational institution; the construction of standards and the testing and calebration of standard testing apparatus, and the determination of physical constants and properties of matter.

The importance of this measure to the electrical industry lies in the solution it offers to the problem which committees of the American Institute of Electrical Engineers and the National Electrical Light Association have been laboring over for some years—a source from which secondary incandescent lamps standards may be obtained, and to which electrical measuring instruments may be sent for verification. It will be recognized by all how pressing these needs have been. The committees of the organizations named, though criticised for having produced no practical results, have, nevertheless, bestowed much labor to the task assigned them. The matter of secondary incandescent lamp standards, for example, has been thoroughly studied and the necessary requirements formulated. When it came, however, to a source from which such standards could be obtained, all progress stopped. The only practical suggestion offered was to confide the work to the laboratory of one of the technical schools, but aside from the feeling which would result from this action among the rivals of the school selected, the organization of college laboratories is scarcely of a kind to justify placing with them work of the industrial character proposed. In Europe the condition thus presented is met by governmental institutions, and the measure now before Congress will place us in this respect on a parity with other industrial countries. It is most sincerely to be hoped that Congress will take favorable action in the matter, and its importance to the electrical industry should secure for it hearty support from all connected with that industry.

WEHNELT INTERRUPTER CIRCUITS.

It is admitted by photographers that in spite of popular impression to the contrary, nothing can be more deceptive than a photograph under particular conditions. In a similar manner Mr. Hanchett's article in this issue shows that under particular conditions nothing can be more deceptive than the observations of direct-current measuring instruments on a direct-current circuit. The particular condition in this case is a direct-current circuit including a Wehnelt interrupter. The conditions are both peculiar and complex; there is a steady pressure from the mains driving the current through the interrupter, and the direct-current instruments measure this effective pressure, and the time integral of the electric quantity delivered under that pressure. Superposed upon this direct-current circuit is a pulsating e. m. f. of relatively great magnitude. Theoretically, if the bubbles formed in the interrupter chopped off the current as a knife cuts the stem of a flower—with perpendicular abruptness—the induced e. m. f. would be infinitely great, and in the same direction as the steady pressure from the mains. In practice, of course, the abruptness can only be moderate in degree and in the induced e. m. f. rises to a momentary impulse of considerable magnitude. This peaked wave of induced e. m. f. encounters some electrolytic capacity in the plates of the interrupter, and does work in charging them or storing electricity in the cell. The moment the impulse of e. m. f. has spent itself in this way, the cell discharges back through the circuit against the pressure of the mains, and restores part of the stored energy, at the same time unfastening the electrolytic seal between the plates and restoring the continuity of the circuit. This back wave of e. m. f. and current is, of course, not detectable upon an ordinery direct-current instrument.

The circuit is, therefore, a direct-current circuit with a superposed pulsatory e. m. f. giving rise to an alternating, superposed current with dissipation of energy. The alternating-current circuit possesses both inductance and capacity and the alternating potential differences are therefore out of step with each other. The inductance in the circuit is partly in the coil and partly in the direct-current dynamo, while the capacity is probably wholly in the interrupter itself. It is interesting to observe that in spite of the complex actions taking place, the power delivered to the circuit seems to have maintained a fair degree of uniformity with that which corresponds to the product of the direct-current volts and amperes, showing that the direct-current circuit is the source of all the actual power, and that the alternating currents superposed upon the system are merely disturbing elements in the distribution of the energy.

INDUCTIVE E. M. F'S. OF TRANSFORMERS.

In the ordinary alternating-current transformer, the drop of pressure due to ohmic resistance is comparatively small. It is the drop which is incident to all conductors, and is the price which has to be paid for the services of conducting metal in conveying the electric current. Until we find some means of treating copper which shall increase its conductivity, or discover some new conductor of greater conducting power, we shall be content with the limitations imposed upon us in the regulation of transformers by the resistance of their coils. We can always improve this regulation when we wish to do so at the expense of copper, or of iron, or of both.

The other source of drop in a transformer is, however, that due to magnetic leakage, and is apt to show itself in a marked manner when the transformer is loaded inductively. This source of drop is due entirely to the fact that the magnetic fluxes of the two coils exhibit a selective behavior and do not link so freely and fully with the primary and secondary windings as they should. By this selection some of the flux induced within the primary coil omits to pass through the secondary coil and vice-versa, and each coil behaves as though it were composed of an external choking coil associated with an internal induction coil devoid of magnetic leakage. If magnetic flux could be insulated or restricted from leaking or deviating into useless by-paths, the inductive drop of pressure in transformers could be eliminated. As the matter now stands, the primary and secondary coils have to be associated together as closely as possible to reduce magnetic leakage, and yet they have to be carefully separated from each other conductively in order to maintain their relative insulation.

Mr. Whitehead's article in this issue deals with the graphic representation of the drop of pressure in a transformer and with the algebraic estimation of the inductive drop as dependent upon the relative association of the primary and secondary coils. It points to

the importance of breaking up these coils into sections and mutually interspersing them. The relative magnitude of the inductive drop in transformers increases with the pressure which they generate, for the reason that greater space has to be allowed for the insulation and separation, and such space is immediately occupied by leakage magnetic flux. As the pressure maintained on the transmission lines of alternating-current systems increases, the inductive drop tends to increase for the same size and capacity of transformer; or, in order to maintain the same percentage of inductive drop, larger transformers must be used. The only mitigating circumstance in such cases is, that where the line pressure tends to increase, the capacity of the transformers also tends to increase, and in this way the inductive drop of pressure can usually be restricted to some extent. The case is similar to that developed in dynamos. The same iron skeleton can be wound either for a high or a low pressure, disregarding the changes brought about in the commutator by reason of changes of terminal pressure. The output would remain practically the same for all pressures, if it were not for the relatively large insulation space rendered necessary with increasing pressures, so that finally the conductive drop in the reduced space left for copper wire markedly affects the output.

POLYPHASE ISOLATED PLANTS IN LARGE MILLS AND FACTORIES.

In spite of the disadvantages which have been urged against the alternating-current motor as compared with the direct-current motor, for the individual driving of machines at various speeds and various torques, there is nevertheless developing throughout this country an application of the induction motor to heavy power distribution on a scale and magnitude most surprising to those not immediately in touch with it. This application is in the use of polyphase generators and induction motors to take the place of long mechanical drives in large mills and factories, and to drive from one powerhouse several mills or separate shops of one factory so large that they could not all be reached mechanically without excessive cost and friction losses. As generally carried out, each shop or section of a mill is driven by an induction motor, belted or coupled to a line shaft, thus allowing the motors to run at a high and constant speed and with a practically constant load, under which conditions the induction motor is a highly satisfactory piece of apparatus. At present the application does not appear to be extending to the driving of individual machines by direct-coupled or direct-geared motors of small sizes and low speeds, for which service, in the present state of the art, the direct-current motor is ideally fitted. The advantages of the alternating system with large group-driving motors over a purely mechanical drive, are the saving of losses in the main drives and the concentration of several large drives on one power station. The advantages of the short line shafts and belting between each large motor, and the several or many machines it drives, are endured, being, of course, in part or in whole, balanced by the advantage of one large motor over several small ones.

Installations of this kind are usually of much greater magnitude than ordinary direct-current, isolated plants. Paper mills, flour mills, cotton mills, grain elevators, large factories, etc., where this system is coming into use, require a very large amount of power. It is also notable that many mills which have adopted this system in its early days, are now installing much larger equipments—a most forcible proof of the satisfaction it gives. The last three statements are well illustrated by the following cases: The Deering Harvester Company of Chicago, which started with 1000-hp equipment, is now enlarging it to 5000 horse-power. The Lancaster mills at Clinton, Mass., which started with about 1500 horse-power, are now more than doubling the original plant. The Great Northern Paper Company, with one paper mill in the State of Maine, using about 1000 horse-power distributed in this way, is building another with similar apparatus for the distribution of 3000 horse-power. The Great Northern Elevator Company, whose grain elevator in Buffalo, N. Y., driven by induction motors obtaining power from Niagara Falls, was a radical experiment when built, is now installing similar apparatus with a capacity of 2000 horse-power. In West Superior, Wisconsin, similar cases of textile mills, wood establishments and other industries which started in with induction motor distribution on a comparatively small scale and are now enlarging to very large-sized plants, might be cited to great length—the few given above being simply typical examples.

In considering such plants, there arises at once the question, What are their advantages over direct-current distribution? Engineers connected with them who have had experience with direct current claim that the operation of the alternating apparatus in dusty and exposed locations, is far superior to that of direct-current machines. There is no need of enclosing the motors dust-tight, even among such extremely unfavorable surroundings as those of a foundry, for instance. There is no need, or underwriter's requirement, of a starter with springs, magnets, etc., which deteriorates and gives trouble where the atmosphere is thick with dust. All that is needed in many cases to start, stop and protect an induction motor, is a switch and some fuses. The former can be put under oil, if necessary. If the motor is large compared with the capacity of the generators or line supplying it, or must be started under heavy loads, it may prove advisable to use a compensator and a throw-over switch for starting it, but these devices are much more robust and less liable to give trouble, than the usual starter with its automatic features. Practically, the maintenance is the same as that of two line-shaft hangers. After two or three years of service, the bearings may have to be renewed, and from time to time their oil wells must be refilled. Otherwise, no attention is necessary. No amount of dust can injure the internal parts, and the centrifugal fan blast of the revolving member prevents the dust from choking the ventilating passage.

With loads, such as those of mills or shops containing large numbers of small tools belted to one motor, and where the load on the motor is nearly constant, no trouble is experienced with lagging currents. With large motors loaded up to nearly their rated capacity, it is easy to keep the power factor up to 80 per cent or 85 per cent, a ratio giving no difficulty in generator excitation or serious increase of line losses. An advantage of the alternating motor over the direct is the ease with which a whole mill or factory can be started up and shut down from the engine just as though the mill were mechanically driven, no local attention at the motors being required. This is accomplished by leaving the motor switches closed and starting up and shutting down the main engine at the proper hours in the usual way, the exciter being separately driven. With the field of the main generator at full charge, the motors all gain speed with the engine, starting the mill just as though the driving were done entirely by mechanical means. This cannot be accomplished by direct-current motors as usually wired, but would require separate circuits for field excitation, and considerable modification of the starting arrangements at present used.

In the present state of the patent situation in this country, this extending use of alternating currents in place of direct-currents for isolated plants, as well as the extending use of polyphase current apparatus to supplement direct-current machinery in lighting and traction work, has an important industrial bearing, in that it carries more of the electrical construction work into the hands of the several larger manufacturing companies. However this situation may be extolled or deplored, it appears indisputable that polyphase currents are forcing their way as rapidly into isolated plant work as they are into traction and have already done into lighting.

Opening of the Paris Exposition.

With due pomp and ceremony the great Universal Exposition was opened on April 14 by President Loubet in the presence of 15,000 people, in the great Salle des Fêtes, which occupies the middle portion of the fine Machinery Hall, the substantial remnant of the exposition of 1889. Thus was the work of the present linked with that of the past; and the augury was happy, for it is ever out of the industrial and mechanical that the softer arts and humanities spring as evidences and triumphs of civilization. It was a stately spectacle, worthy the traditions of a people whose sense of artistic proportion is unsurpassable; and it was one in which the brilliant military element did but serve to throw into higher relief the peaceful attributes of an exposition destined, as Mr. Jules Roche, the Minister of Commerce in 1894, said, to constitute the summing up of the nineteenth century and to set forth its practice, its principles and its philosophy.

In America it is the fashion to start an exhibition by pressing a key, which is fondly supposed to energize circuits putting the machinery in motion. Thus at Chicago, in 1893, the use of a telegraph key by President Cleveland was regarded by the public as the tangible, visible act of inauguration, and one enterprising showman offered $3000 for the privilege of putting the marvelous little instrument on view in his dime museum. At Paris, there was an entire abstinence from spectacular episodes of such a character, and the exercises were wholly musical and oratorical. Even had a key been pressed there was no machinery to start up at its summons. It is said that President Loubet did not inaugurate an exposition, but several façades, and that now the show is open it is time to get ready with the exhibits.

M. Millerand, the Socialistic Minister of Commerce, Posts and Telegraphs, made an excellent address from the temporary tribune on the floor of the vast arena. He emphasized in particular the importance of steam and electricity. The machine had become the ruler of the world, and flesh and blood were being relieved from toil by creatures of steel and iron. Distances were diminished, weeks were reduced to hours and minutes, and by the telephone the very voice of a friend hundreds of leagues away was heard on the instant in all its familiar accents. In turn, President Loubet made his discourse, and in an admirably brief, terse welcome to all nations in the name of France, affirmed that it was not merely a holiday spectacle to which they were invited, but a grand school of instruction in the arts and sciences and in the secrets of civilized life. He again struck the scientific note, and in referring to those who were to be thanked for the work of creating the exposition before them, named first and foremost of all, the engineers.

The exercises in the Salle des Fêtes lasted in dusty splendor for about an hour, and at 4 p. m. the President started out on his inaugural tour. The very first exhibits to encounter his gaze were electrical, and his path through Electricity Building brought him directly along the front of the American Court of Honor, where the United States guard under Capt. Bowen was drawn up. Messrs. Drake and Anthony, who were in charge, were joined at the instant by Commissioner General Peck and his assistant, Prof. Woodward, all of whom stationed themselves before the show cases containing the relics of Henry, Morse, Brush, Thomson, Edison, Farmer, Bell and others. Colors were dipped, and President Loubet's grave face relaxed in a pleased smile as he passed forward to the higher platform of the Chateau d'Eau and saw the water turned on its cascades. He and his immediate escort of ministers of the cabinet, ambassadors, exposition staff, commissioners general, etc., then took steamboat on the Seine, past the United States and other buildings on the Street of Nations and landed at the new Alexander Third Bridge, to open the part of the exposition there.

In the evening all Paris was finely illuminated, including a large portion of the Exposition, although no current was available from the service plant. The Eiffel Tower, outlined on every side in incandescent lamps with reflectors, the whole height of its thousand feet, and backed by a soft full moon drew every eye. It was noticeable that very little use was made of arcs, while gas jets were in the utmost profusion and variety on public and private buildings alike. The Esplanade des Invalides section also had the interiors of some of its buildings lit up with arcs and incandescents for the first time, the current being drawn from outside sources.

The following day, Sunday, was virtually the opening for the public, the exercises on Saturday being visible only by card, while admission to the Salle des Fêtes required another card, a formal invitation from the President himself. Incomplete as the Exposition is, the lovely April weather sufficed to bring 250,000 people into the grounds, all of whom seemed to enjoy themselves greatly, except perhaps in the deep gorges and precipitous passes of Electricity Building, in regard to which one of the journals has humorously suggested that the Exposition guides taking parties around there should for the present be equipped á la Suisse, with alpenstock, spiked shoes and rope.

The moving sidewalk went into full operation on Sunday, and was immediately resorted to not only by visitors but by exhibitors who have been sorely in need of some such means of transportation from one part of the grounds to another on business errands. A great many thousand passengers were carried, but it was extremely curious to see how few of them stand still. Nearly everybody walks, so that the speed of 5½ miles an hour is considerably increased at will. The transmission plant and the motors operated admirably. The sidewalk is already a great hit, the only criticism being directed first against the fact that there are no seats on it, and next against the rumbling noise which accompanies its movement. The fare for the trip, which may last all day if one desires, is 10 cents; while that of the third rail system, also about to go into operation, is 5 cents. No tickets are issued, registering turnstiles being used.

The New Plant for Lighting the Streets of St. Louis.

The city of St. Louis, Mo., has given the Seckner Contracting Company, of Chicago, a contract for lighting the streets of St. Louis for ten years. The contract calls for 900 arc lamps at $97.50 per lamp per year, and 600 32-cp incandescent lights for the alleys, the total compensation amounting to $100,800 per year. The contract also grants the franchise to do commercial work during the same period, but contains no provision for a renewal of the contract or purchase of the plant at the end of the ten-year period. All wiring must be put under ground.

The Seckner Contracting Company has formed, for the purpose of carrying out this contract, a local corporation termed The City Lighting Company, with a capital stock of $600,000, and an authorized issue of 5 per cent first mortgage gold bonds to the same amount. It is estimated that the bonds will pay for the necessary plant, and the contract will pay the interest upon the bonds, the operating expenses and refund the bonds, leaving the plant, at the end of the ten-year period, as profit on the stock, in addition to any profit that may be obtained from commercial business. T. B. Potter, of Chicago, has the bonds for sale.

The new plant will be located on the river front in the down-town business district of the city, opposite the Laclede Gas Works. The building will be 90 x 140 ft. in size. The boiler room will contain Heine boilers with an aggregate capacity of 2000 horse-power. Ideal engines will be used, each belted to four Fort Wayne arc machines, mounted as usual on a balcony above the engine room level.

Messrs. Bryan and H. H. Humphrey are acting respectively as the mechanical and electrical engineers, representing locally the Seckner Contracting Company. All the plans and designs must before adoption be approved by B. J. Arnold, of Chicago, who acts as the consulting engineer of the bondholders. The load which will be carried by the new company will be taken from the Missouri Edison Company, the Edison licensee in St. Louis. Mr. J. H. Brown is president, and Mr. George Mayer is secretary of the Seckner Contracting Company, with offices in the Rookery, Chicago.

Strike of Electrical Workers.

On April 25 about 1500 electrical workers in New York went out on strike for an advance of wages from $2.50 to $4 per work-day of eight hours. One of the principal buildings affected by the strike is Mr. Vanderbilt's new home in Oakdale, L. I. About twenty firms signed the new agreement and 400 men returned to work. None of those who signed, however, are members of the Electrical Contractors' Association, which decided at a meeting to resist the strike.

Electricity at the Paris Exposition of 1900.

ONE of the best ways to measure the dignity and importance of a universal exposition is to compare and contrast it with its predecessors. The only suitable standard by which to form a relative idea of the work in Paris is the Chicago World's Fair of 1893. The preliminary data and fugitive articles that have appeared already in these columns constitute first steps towards a fair realization of what the French nation has proposed to do in organizing an exposition which should fittingly sum up the achievements of the century in science, art, literature and the essentails of advancing civilization. Now that the Exposition has opened its doors, the time is appropriate for treatment of a more precise nature. It will still be some time before the Exposition is complete in all its features and exhibits, but even now the main elements and characteristics are plainly discernible. The Chicago Fair was one of magnificent distances, its 800 acres at Jackson Park curving horseshoe fashion for a mile and a half around the shore of Lake Michigan, and it was notably an architectural display, the ample space allowing the white palaces due perspective. But while at Chicago the wide-stretching grounds were happily suggestive of prairie freedom, here in Paris, an exposition planted right at the heart of the city has no such chance of liberal elbow-room. The buildings are not less beautiful than at Chicago, and are more decorative. The outdoor spaces are less open, the roads and alleys are narrower. In some parts of the grounds the crowding of edifices would have led to confusion but for the French skill in creating attractive vistas.

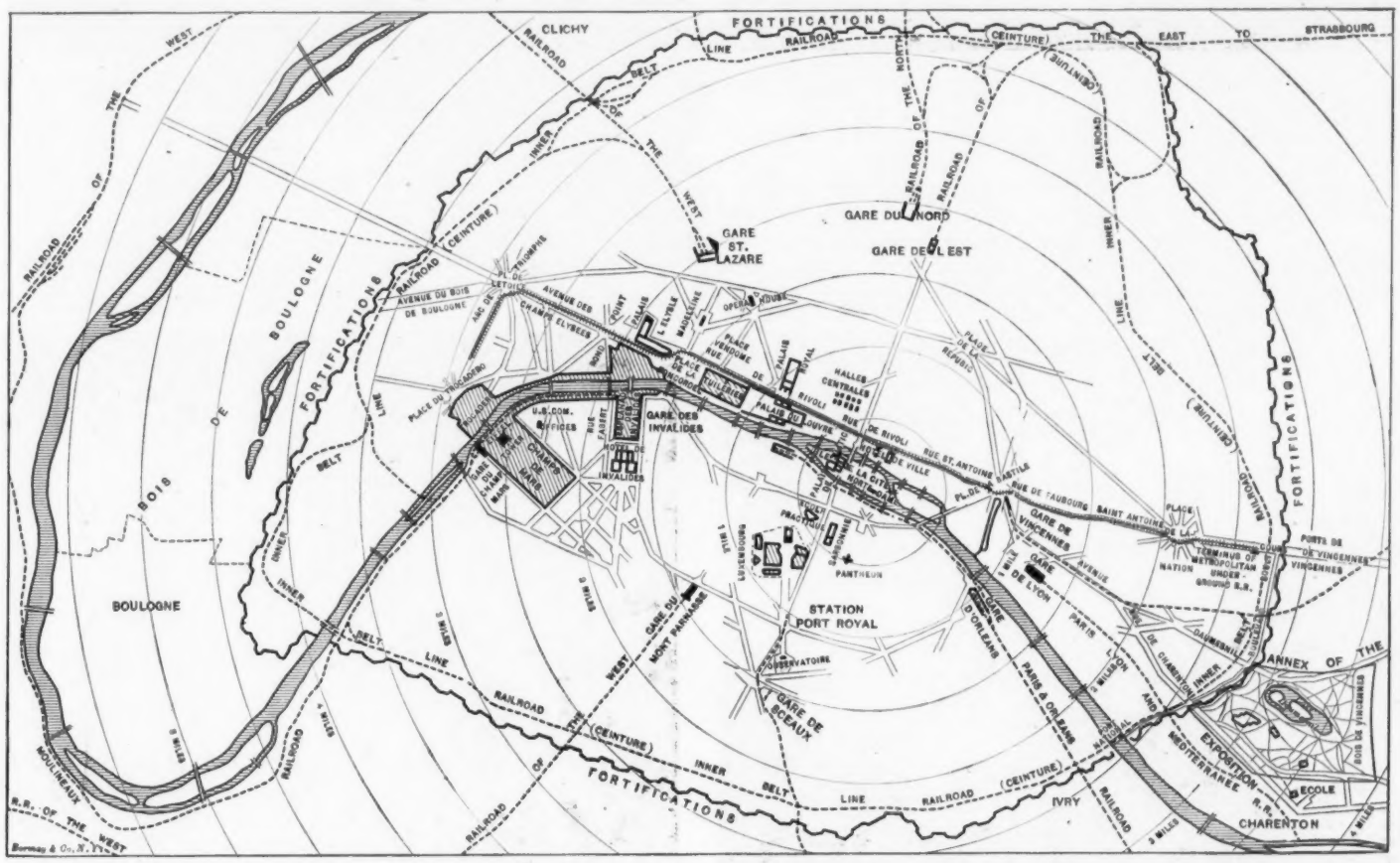

FIG. 1.—OUTLINE PLAN OF PARIS, SHOWING MAIN EXPOSITION GROUNDS AND OFFICIAL ANNEX AT VINCENNES.

But after all, an exposition is not merely buildings; it consists in what those buildings contain. While a perfect environment is desirable, the objects to be studied are the thing. An exposition to be successful must comprise all the triumphs of hand and brain which may be called the "Furthest Norths" of human endeavor. In this respect Paris in 1900 bids to achieve its lofty purpose. Moreover, those who found the work of circulation at Chicago very fatiguing will not be sorry that here the contraction of area makes it much easier to travel around and see everything. The total of the grounds is probably about 500 acres, of which some 175 lie at Vincennes. It is unfortunate in some ways that the Machinery and Transportation Annexes should have been banished to that Bois six miles away, but there seems to have been no escape from it. A great many people interested in mechanical and electrical apparatus will welcome a separate excursion on the river to those leafy woods, when hot days come.

LIGHTING AND POWER.

Obviously an area restricted to the dimensions above noted is much more susceptible to proper treatment for light and power than was Jackson Park, and it is not to be wondered at, therefore, that the provision made for such service is on a less colossal scale. Nevertheless, the advance in magnitude over the former Paris Exposition plant of 1889 is remarkable, especially from the standpoint of electrical requirements. At Paris, in 1889, the total steam power for electrical work was about 3000 horse-power, although some 5000 horse-power was actually available. At Chicago in 1893 the steam plant, designed and directed by W. F. Sargent, was at least seven times as large, and the use, in official service lighting, reached in the vicinity of 15,000 horse-power. This year at Paris the conditions are different and varied, for the service plant is supplemented by outside supply and by gas. Jackson Park was, it is believed, entirely without gas; here the gas lamps are very much in evidence, as for example, on the avenue down from the Trocadero to the very foot of Electricity Building. They may not all remain, but at the instant they are extremely useful, when all the ground is encumbered and entangled with debris. Mr. Picou, the French Exposition director of this branch of the work, estimates the power plant installed as about 40,000 horse-power, of which 15,000 to 20,000 horse-power will be active and in operation for serious work.

Looking toward Paris from the left and southeastern bank of the Seine, the Exposition takes roughly the shape of a V, or it might perhaps be better described, when seen from the right and northerly bank, as looking like a blunt letter A, the bar across the two limbs being formed by the exhibits along the river shores. At the left arm of the letter concentrate the higher industries and the finer arts. At the right arm of the letter are massed electricity, civil engineering, mining, mechanics, chemistry, weaving, spinning, agriculture, etc.; the basic arts and industries, in short. Here, there-

fore, are naturally found the electrical section and the power plant. The old Trocadero and its entrances are in the foot of the limb; midway is the Eiffel Tower buckling the cross-bar; and seen through its gigantic arch, closing in the vista of the Champ de Mars, is the Chateau d'Eau, immediately behind which lies Electricity Building. As a matter of fact, there are not, as might be inferred, several separate buildings around the Champ de Mars for the industries

FIG. 2.—MONUMENTAL ENTRANCE, FROM THE RIVER.

named, but one vast, continuous structure, divided up, however, by huge porticos, ornamented angles and be-lettered entrance pavilions for purposes of direction. It was at one time proposed to use electrically-made aluminum for this immense construction, but that metal must await another "universal" before it can compete with the steel here shown in so many light and graceful forms. Back again of the electrical and power section lies the old Galerie des Ma-

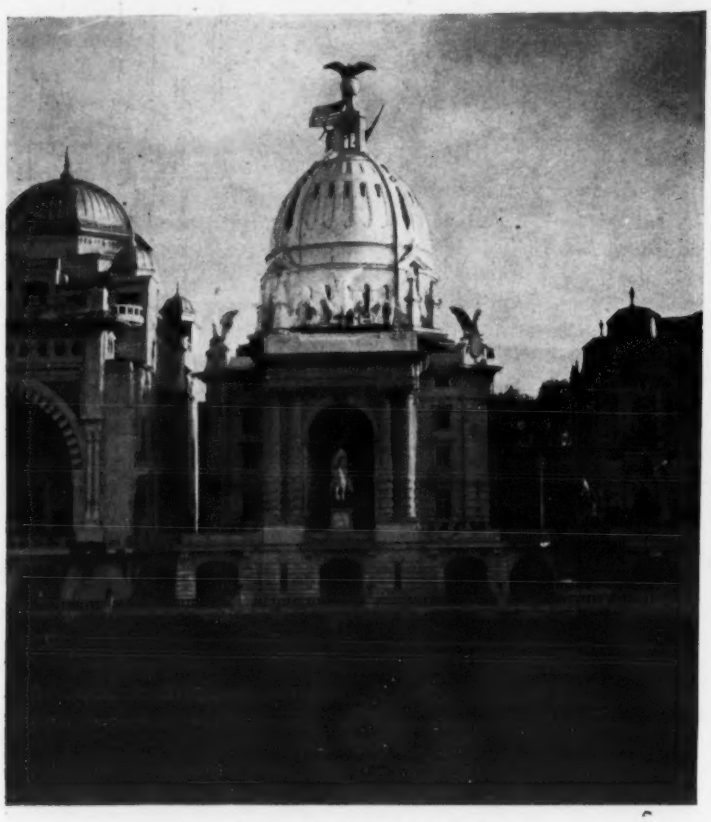

FIG. 3.—UNITED STATES PAVILION.

chines, whose memories will be pleasantly familiar to many American engineers. To-day it is devoted to agriculture, the latest comer in the band of mechanical and electrical arts; while within it again, an imperium in imperio, a complete building in itself, like one part of a Chinese nest of ivory eggs, is the Salle des Fêtes, where all the great official functions are to take place. Flanking the electro-mechanical section, at each end of the building rises a beautiful big brick smokestack, that to the left caring for the French boiler plants and that on the right answering for all the foreign boilers. It will be seen at once that an admirable topographical disposition has been effected by the authorities, the power plant being located where most

FIG. 4.—CHATEAU D'EAU, SHOWING UPPER TERRACES IN COURSE OF CONSTRUCTION.

of its energy is to be distributed or utilized. There is a great feature of novelty incident, however, to the situation. The plan of the Exposition has been to group wherever possible, any given product with the machinery working up the raw material. With steam distribution this would have been literally impossible, and resort must have been made to carry it out, to the

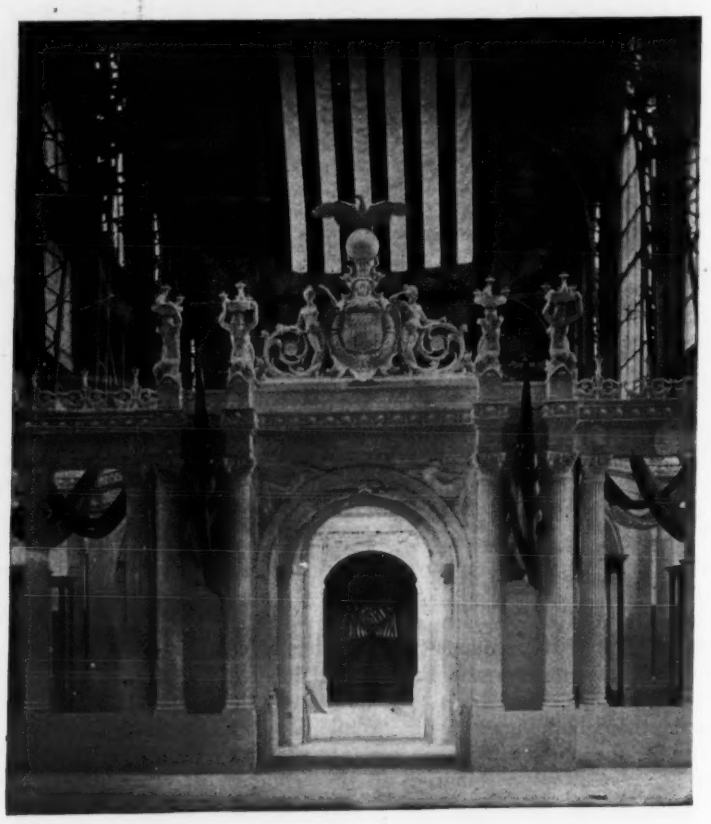

FIG. 5.—UNITED STATES COURT OF HONOR.

old plan of the Galerie des Machines, or that of Machinery Hall at Chicago. But with the application of electric power, the new method of exhibition, which is strictly scientific, has been rendered very feasible. As one enters the Exposition at the Monumental

Gate on the Place de la Concorde there are to be statues of Electricity to impress the visitor with the vital importance of this agent in modern affairs, and as one goes from building to building, always encountering electrical apparatus of some kind, the impression is deepened, until it receives its most profound stamp at the other extremity of the grounds, in Electricity Building, where the allegorical Genius of Electricity brandishes aloft its dazzling Torch of Progress. Accidental this arrangement may have been, but the harmony of the appropriate has certainly worked itself out in such a perfect plan.

THE STEAM AND ELECTRICAL PLANT.

The steam plant occupies two large steel-girder open sheds, which may be said to form the connecting link between the new Electricity Building and the old Galerie des Machines, now Agricultural Building. One of these sheds, on the Avenue de la Bourdonnais, is reserved for the apparatus in the French section. The other, on the Avenue du Suffren, is for foreign apparatus, and each bears a corresponding name. The steam mains are carried across a narrow alley to the "electrogene" units in Electricity Building, and the smoke flues lead each way, right and left, to one of the chimneys, downdraft being used. The boilers are back to back in two parallel rows, and are in great variey of sizes, types and makes, including American. Steam is generated at a pressure of 142 pounds to the square inch, variation 10 per cent. The steam piping, water piping, etc., is carried pretty generally around in large subterranean galleries of

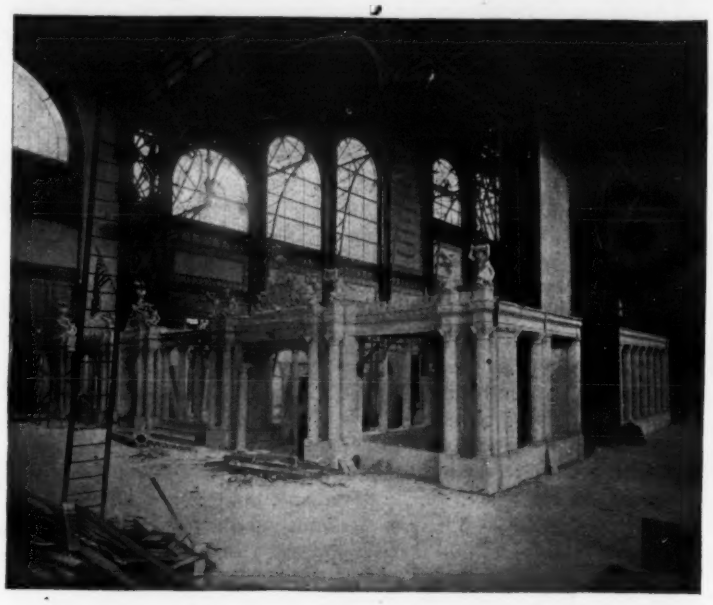

FIG. 6.—UNITED STATES COURT OF HONOR, OPENING WEEK.

three types, but there will be several exhibit units near them not in motion. About 200 tons daily is the estimated coal consumption. The central station plant, also, of course, all exhibitional in nature, in Electricity Building is in two large sections, French and foreign. The two smokestacks, each of a different rich pattern in brick and ceramics, rise to a height of 260 feet from the ground and go down 27 feet from the surface. At the base they are said to be nearly 10 feet thick, with an internal diameter of over 20 feet narrowing upward. There is no core.

According to the present official diagrams of Mr. R. V. Picou, there are 33 dynamos included in the service plant, all direct connected and ranging from 500 horse-power up to 2400 horse-power. Current is to be delivered at the switchboards at voltages of 2200 for alternating current, single phase and polyphase, with a frequency of 50 periods per second; direct current at 125, 220, 440 and 500 volts. Mr. Picou states, however, that dependent on location 5000, 3000 and 2200 volts alternating will all be obtainable. The same quality and nature of current is not delivered everywhere, so that lights and motors have to be adapted to that available in the respective sections of the Exposition. Fig. 10 shows the distribution of current. With the dynamos are 80 individual switchboards, and there will also be plenty of static and rotary transformers.

As to the boiler plant, which is here operated by coal furnaces, it may be noted that Chicago in that respect was a peculiar exception, no coal being used. The boiler room adjoining Machinery Hall, driving seven acres of engines and dynamos, was concentrated into a length of 100 feet. Its fuel was oil brought by pipe line from Indiana wells, and the place was perhaps the cleanest of its kind ever seen. The men did not wear white kid gloves, but they were certainly to be seen at their work in white duck suits. So far none of the boiler tenders at the Paris Exposition have got into their parade uniforms, but it is safe to assume that the colors will be sombre.

FEED WATER AND CONDENSATION SUPPLY.

While the Paris Exposition cannot get oil for its boilers, the water supply is more plentiful than that of coal, a fuel now very scarce in France, and very high-priced. The scheme of water supply is closely associated with the operation of the Chateau d'Eau, which stands as a beautiful frontispiece right outside Electricity Building, facing toward the Eiffel Tower and the Trocadero. Water is pumped up from the Seine by a fine Worthington pumping station on its left bank in a special building by itself and is delivered to a tank or reservoir elevated on a platform within the chateau about 115 feet above the river level. This is supplemented by a supply from the city water mains on the adjacent streets, if and when necessary, and thus not only is the water furnished for the boilers and for condensing purposes but for use in case of fire. The water descends first from the hemispherical niche or source in the cavity of the Chateau, nearly 100 ft. wide by 36 ft. deep, and is caught in a series of basins, which widen out until they reach the level of the esplanade of the Champ de Mars. The waterfall is said to be nearly 100 feet high and has a front of

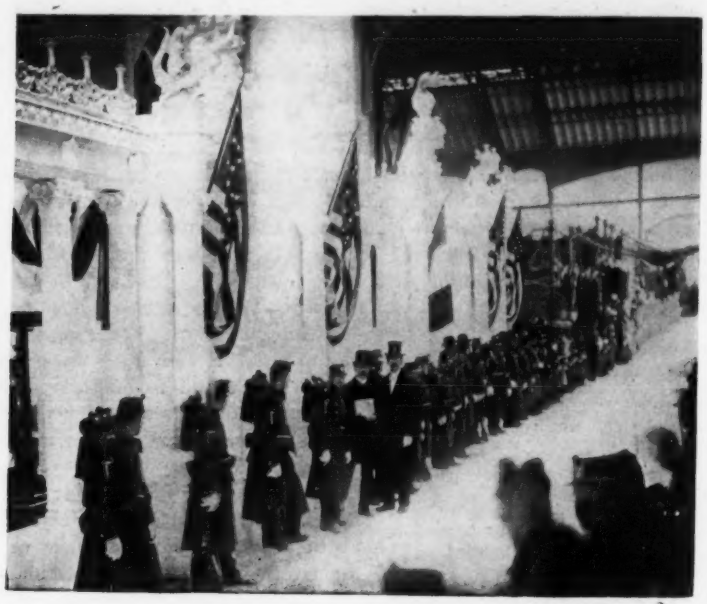

FIG. 7.—UNITED STATES GUARD ON OPENING DAY.

over 32 ft. Here with such a quantity of water—the two boiler plants requiring over 50,000 gallons per hour for steam—hydraulic effects will be produced by day more imposing than those associated with the fame of Saint-Cloud, and at night a veritable fairyland will be created by the lavish use of electric light and colored fires. Nearly 7000 incandescent lights will adorn the fronts of the Chateau d'Eau and Electricity Building; while many arcs, aerial and submerged, and searchlight beams are to converge from every direction. In 1889, the great exhibition fountain display was that at the Trocadero, but now an additional, a greater and a more beautiful electric fountain is thus set up at the other end of the long Champ de Mars. Very different also is the scene from that offered at Chicago in 1893 by the two wonderful electric fountains designed by Mr. Luther Stieringer, the consulting electrical engineer of the Fair, and placed one on each side of the MacMonnies Neptune fountain. Here at Paris both the old effect and the new is that of cascading. At Chicago the basins were on the level of the eye or below it, and the light was projected upward through spouting water by holophotes concealed in the watertight working chambers beneath. The Stieringer fountains required about one and one-quarter million gallons per hour, and were fed through a 24-in. main by Worthington pumps. So far as is recalled, they had no direct connection of utility with the steam plant. It might be added that a plan something like that worked out in the Chateau d'Eau was proposed some time ago for the Pan American Exposition at Buffalo in 1901. It will be very interesting to see what

further innovation can now be attempted in this charming field of work.

A word is due in passing to the Worthington pump installation referred to above. It is larger than that furnished for many cities and has been carried out in regal style. Mr. A. Marichal, engineer of the Société Française des Pompes Worthington, a gentleman well known in the United States, is the designer and in charge, while Vice-Presi-

FIG. 8.—A TERRACE OF THE CHATEAU D'EAU SHOWING PROJECTION BOXES.

dent Moore is also on the ground to supervise in person. The beautiful building is one of the largest outside the official structures, being 165 ft. high, 165 ft. also in length, and 50 ft. wide, painted pure white with a dome. For its size it is said to be the lightest pumping station edifice ever built, the metal work weighing 80 tons and the whole 200 tons. It has a lighting plant of its own driven by Laval steam turbine, furnishing 1400 lights, of which 700 sparkle in two handsome Worthington signs. The company had to build its own quay to carry the structure and to build separate foundations for the pumps, of which there are four in place, representing a capacity of not less than 40,000,000 gallons per 24 hours. The intake from the Seine is about 6 ft. below the surface of the river. The water is not tidal and serves for boiler purposes, although it cannot be recommended for drinking; the remark of Mirabeau that Parisians urinated into their own tumblers being as true to-day as regards the sewage use of the river as it was a hundred years ago, for the Seine is a source of "potable" water supply. The plant is driven by four Babcock & Wilcox boilers, French make, of 125 horse-power each. The smokestack is invisible, being concealed entirely in the hydraulic elevator shaft which runs clear to the top of the building. There are private offices, reception and banqueting rooms, a large parlor for ladies, a kitchen, bedrooms, bathroom, platforms from which to see the spectacles, rooms for the workmen and a beautiful bridge across the railroad, thus connecting directly with the grounds. In the Machinery and Electricity Building, the Hungarian Worthington Company has another superb exhibit in the pumps already sold to the city of Buda-Pest, capable of delivering ten million gallons every 24 hours. It is such exhibits as these bearing the stamp of American genius and elaborated with such generous enterprise by the European representatives that make an American feel very proud of his country. This plant must be treated in detail later.

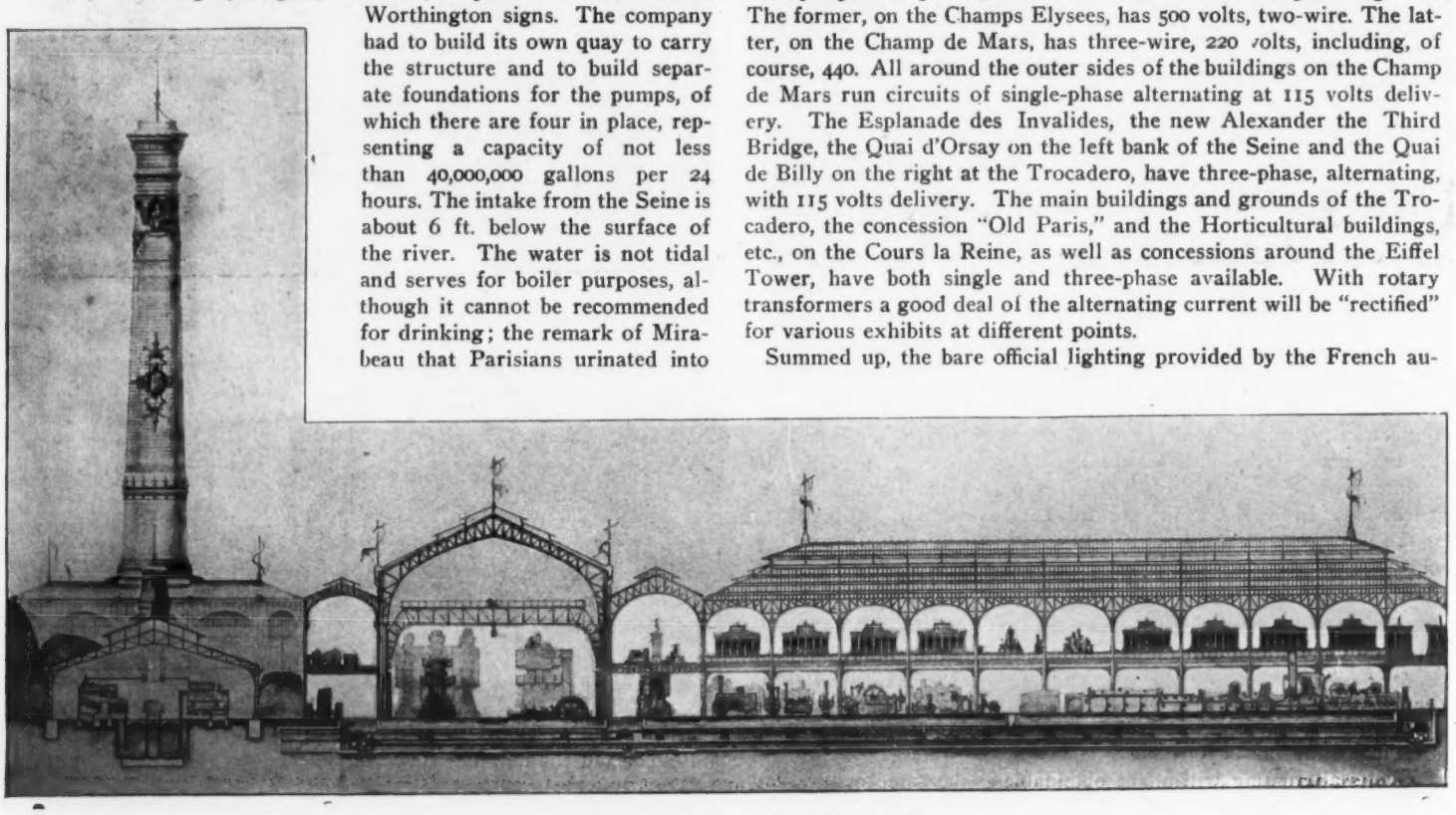

FIG. 9.—SECTIONAL ELEVATION OF POWER PLANT.

SUPPLY OF CURRENT FOR LIGHT, ETC.

The plan of the grounds shown in Fig. 10 will give a fair general idea of the nature of current distribution, subject to more or less modification from the fact that lying as the Exposition does at the centre of a great city, it can be fed into from every direction by outside plants. It has been conservatively estimated by the well-known authority, Mr. E. Hospitalier, that not less than 50,000 electric burners of all classes will be in use in the Exposition, but such a figure seems to fall far below the reality, which can only be ascertained a month or two hence. Mr. Picou's office is still inundated with applications for service for light and power, from exhibitors and concessionaires who have left this important matter until the last moment. The official work has been well done, in sharp contrast to Chicago, where every head of a building wanted for himself all the available 120,000 service incandescent lamps. The French are more economical but true economy is true art. At Chicago, 10,000 lamps were asked for the exterior decoration of one building; 33,000 for the interior illumination of another; and so it went with varying humility all along the line. Aside from the incandescents, there were at Chicago about 5000 arcs, of which some 1600 were scattered over the grounds, set at such a distance from the buildings as to throw them in fine relief. The huge Manufacturers' Building, however, contained about 1700 arcs of 3000 candle-power each, although the best lighting there was obtained from 500 arcs clustered in the five Stieringer coronas all down the main aisle.

The plan herewith outlined shows direct current available at two widely separated points, those of the Fine Arts and Engineering Arts. The former, on the Champs Elysees, has 500 volts, two-wire. The latter, on the Champ de Mars, has three-wire, 220 volts, including, of course, 440. All around the outer sides of the buildings on the Champ de Mars run circuits of single-phase alternating at 115 volts delivery. The Esplanade des Invalides, the new Alexander the Third Bridge, the Quai d'Orsay on the left bank of the Seine and the Quai de Billy on the right at the Trocadero, have three-phase, alternating, with 115 volts delivery. The main buildings and grounds of the Trocadero, the concession "Old Paris," and the Horticultural buildings, etc., on the Cours la Reine, as well as concessions around the Eiffel Tower, have both single and three-phase available. With rotary transformers a good deal of the alternating current will be "rectified" for various exhibits at different points.

Summed up, the bare official lighting provided by the French authorities includes, for general service, some 14,000 incandescents on continuous-current circuits and 4000 on three-phase, with 2650 ordinary arcs, and 208 enclosed arcs, there being 1300 arcs on direct current, 60 on single-phase alternating, and 1500 on three-phase; to which may be added 8 large projectors. This shows a total of about 21,000 lamps of all classes, but there are scores and scores of large

private buildings, etc., that have to be illuminated. The U. S. Commission is wisely going in for a most liberal use of electric light, with 1200 incandescents on the dome of the national building, on the Street of Nations and 1700 inside; 3000 on the facade of the U. S. section in the Diversified Industries Building at the Esplanade des Invalides; 500 on the Court of Honor in Electricity Building, etc., etc. Director F. E. Drake is also using Western Electric enclosed arcs freely in the U. S. section of Machinery and Electricity, with Toerring enclosed arcs in the gallery portion. It seems rather curious that with so much interior work to be done in large spaces, the French have used so few lamps of the enclosed type. The idea has not yet "caught on." If one goes to the Bon Marché, rows of open arcs can be seen in that big store with little glass buckets of water swinging beneath them as spark arresters. Here, again, it would appear that missionary work in export trade will be benefited by the Exposition. Possibly one of the reasons for the slower resort to enclosed arcs may lie in the cheaper labor for trimming.

Data will be reserved until later as to cost of water, steam, compressed air, current, etc., under the varying conditions of exhibitor, concessionaire, etc. It will suffice to note here that current not provided officially, for regular service, is charged at the rate of 10 cents per kw-hour for motive power and 20 cents per kw-hour for lighting. There is a regulated charge for running the special wires and a monthly charge for meters, beginning at 50 cents per month for one of 500-watts' capacity. There is considerable reduction for large quantites of lighting current, larger meters and larger installations.

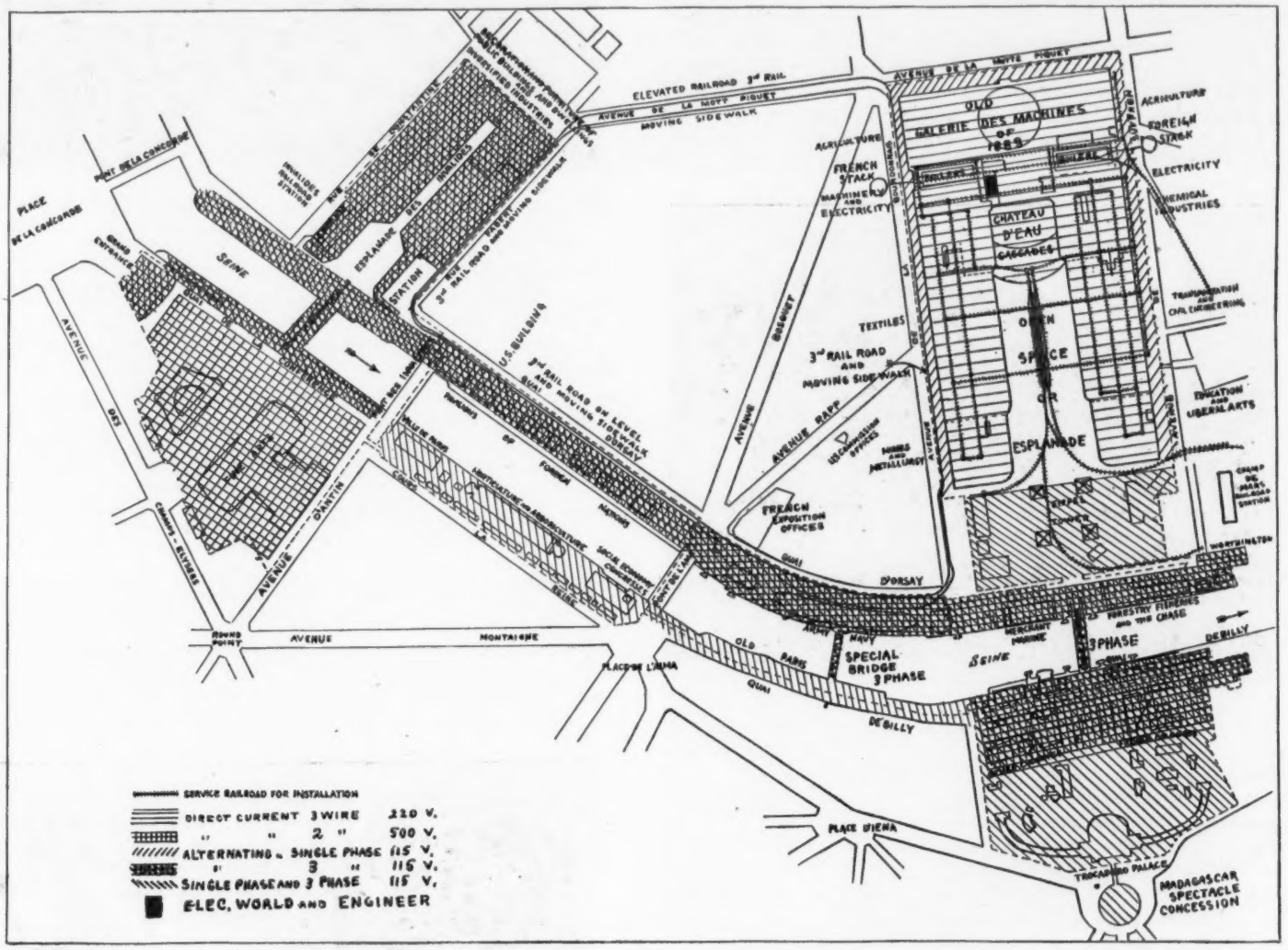

FIG. 10.—PLAN OF EXPOSITION GROUNDS, SHOWING CURRENT DISTRIBUTION.

ELECTRIC MOTIVE POWER.

Throughout the Exposition there is evident a general desire to signalize the triumphs of electricity, and so far as "industry" goes it may be said that every branch of manufacture illustrated this year at Paris has been made to subordinate its needs to the ability of electric power, the object being to concentrate in each building in each exhibit as far as possible the raw material through all its stages up to the finished product. To such a plan, electric motors are obviously essential, and they are being put in right and left. It would be far easier to say where they are not than to enumerate the places where they are. The French authorities do not undertake yet to count them, and have had their work cut out in bringing all exhibitors using power to understand that there is a stringent regulation forbidding anybody to use steam as motive power in any annex or concession, in the Exposition grounds proper. All exhibits must be driven by electric motor, gas engine or compressed air, and this pretty closely resolves itself into electricity, as there is another rule which says: "It is expressly forbidden to put in operation in the buildings any apparatus that will create clouds of steam or vapor, dust, odor, or noise, susceptible of causing annoyance to visitors or injuring other installations or exhibited objects." The result is that for the first time many mechanical apparatus on this side of the Atlantic will be associated with electric motors, and the lesson may be expected to sink deeply into the public mind. In fact, Mr. Paul Janet, the well-known director of the Laboratory of the Société Internationale des Electriciens, of Paris, may be said to have taken special pains to emphasize the opportunity that would thus be afforded, in an address delivered last year before the Industrial Association of Northern France. He showed how the electric motor offered many advantages not found in other power-receiving and transmitting mechanism, and pointed out that under the old methods as much as 45 per cent of the energy furnished would be lost in function, etc.

Reference has already been made to the price charged for current for electric power. There is, however, a rule which says that the Exposition Administration shall make a liberal interpretation of the other article forbidding free distribution of current, and which states that exhibitors who apply in good time can have free current to drive tools and machinery, if they satisfy the management that the object is not a mere mercenary one; otherwise current must be bought and paid for. It will now be seen how the "liberal interpretation" is realized in practice. There are certainly a vast number of exhibits which

are to use electric power for the legitimate demonstration of processes of use and manufacture.

The electrical groups of machinery, as well as apparatus driven, are under requirements as to operation in given hours. Generating units are supposed to have steam up at 9:30 a. m., with a rest from noon till 2 p. m., and from 5:30 p. m. until the lighting circuits go into service. Driven machinery is allowed to run from 10 a. m. till noon and from 2 p. m. to 5:30 p. m. The Director General of Exploitation reserves in every case the right to limit the amount of current that any consumer shall take, so that there shall be no scarcity. Outside the official supply, there is contracted for, the right to draw upon the Companies of the Left Bank of the Seine and of the Section of the Champs Elysees for current, the terms being practically the same, and the quantity specified in the published contract with the company on the left bank being not less than 800 kilowatts. The total energy to be used from the service plant in motors is estimated at 5000 horse-power.

WIRING AND SUBWAYS.

The amount of wiring done or to be done in the Exposition is at present quite beyond accurate estimation. Mr. Picou states that he has laid about 30 miles of armored underground paper cable, and has used some 8 miles of rubber cable for overhead work. These, of course, are mains and feeders, and do not include at all the circuits for telegraphy, telephony, etc., the details of which are in the care of the Department of Ports and Telegraphs. It is amazing how large are the figures into which an Exposition wiring can run, as was

FIG. 11.—OUTSIDE TRANSFORMER STATION, CARS ON TRACK ABOVE.

shown at Chicago. A great difference will be noted, however, by visiting American electrical engineers in the methods now adopted as compared with those of 1893, in their own country. The Chicago World's Fair had a really remarkable system of subways for all wires. They were single and double, about 6 ft. 6 ins. square, and built of tarred planking lined with cement on metal lathing. There were 1500 manholes, and one run was 1700 ft. long. For transformers there were special connecting pits. The subways were all lighted by incandescents. As a temporary makeshift they did very well, but one finds no such system in the Paris Exposition. All the French service wires in buildings and thoroughfares are laid right in the dirt trenches, and hauled in by the sheer brute strength of a long line of harnessed laborers. Road crossings have conduit for protection, but that is all. Chicago used, in addition, iron pipe and pump log, and its main subways carried, in addition to the lighting circuits, 200,000 ft. of power conductors, 350,000 ft. of fire alarm and police signal service, 750,000 ft. for telephone work, 500,000 ft. for main feeder work, 100,000 ft. of branch conductor, etc., all exclusive of "inside" wiring. When all the Paris data is available it will be very interesting to see how it compares with the above.

There are many regulations anent wiring, etc., most of which commend themselves to common sense, such as the entire exclusion of bare wire, a threefold safety factor in carrying capacity, the prohibition of flexible cord; the enclosure of all cut-outs; the use of spark arresters for open arcs. The maximum of current for the final cut-out is fixed at 3 amperes, but a cluster of lamps may take 5 amperes, and each group must be protected by a double cut-out. Flexible cables for scenic work in theatres and café concerts have to be housed in leather throughout their length. The use of combination fixtures is vigorously forbidden. America is far behind Europe by reason

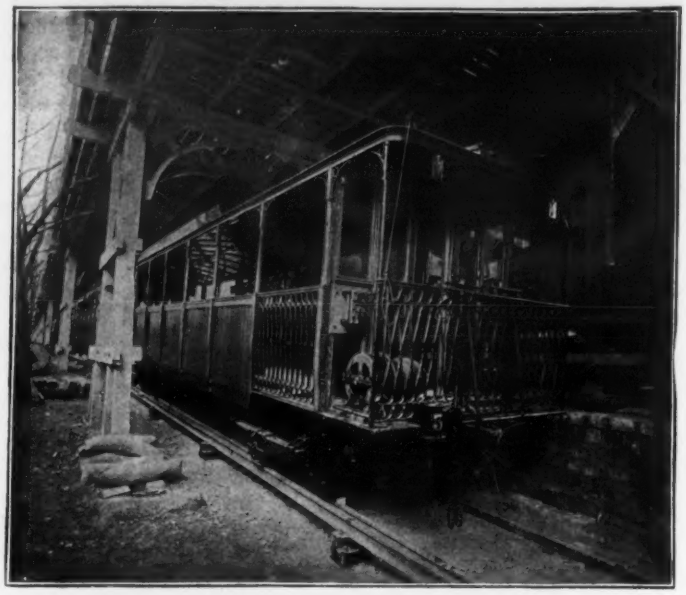

FIG. 12.—MOTOR CAR, THIRD RAIL ROAD, SHOWING CONTACT SHOE, AIR COMPRESSOR MOTOR AND STARTING BOX.

of its adhesion to the ancient cumbrous "combination." The inhabitants of the Old World may not go in so heartily for the use of the electric light as their American cousins, but they at least have ceased to bother about the plant breaking down. Combination fixtures are thus rarely seen in France, and it was hardly worth while to issue an edict against the obsolete. Another rule that may interest is the prohibition of celluloid flowers, shapes, etc., as envelopes for incandescent lamps. Arc lights must be 9 ft. 9 ins. from the ground and the lamps held by incombustible cables independent of the conductors. All lamps must give a wide berth to adjacent inflammable material. Only gas and electricity are permitted anywhere as illuminants, and all the real work, the great work, the main decorative of illumination is electric.

MEANS OF LOCOMOTION.

As with the lighting, so with the transportation at the Paris Exposition; it will all practically be electrical, and the main features will closely resemble those at Chicago in 1893, as there will be once more an "Intramural" railway and a moving sidewalk. These will, however, be much more intimately associated. It will be remembered

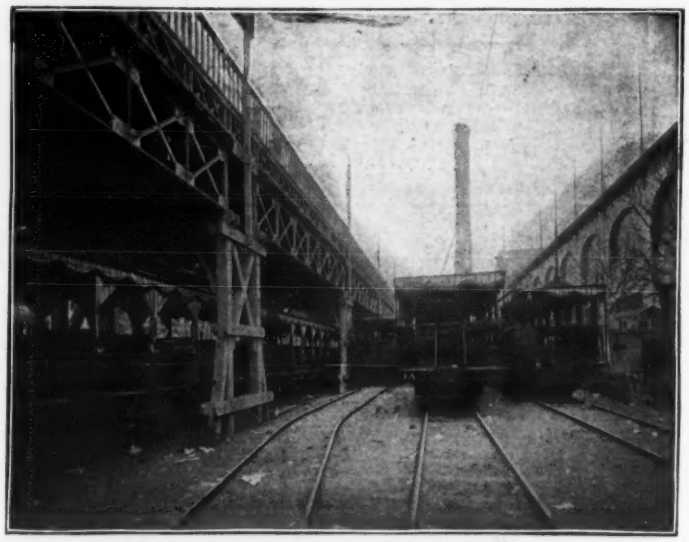

FIG. 13.—CAR TERMINUS. THIRD-RAIL ROAD.

that the two-speed sidewalk at Chicago was away off on a long pier to Lake Michigan, situated at one end of the grounds and which very few people seemed to use. If you wanted to see the novelty you had

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to make a special detour for the purpose. Here at Paris, as the map will show, the third rail exposition road and the moving sidewalk are plump in the middle of the show, so far as access is concerned, and they keep close company, either being parallel and adjacent all the time or else the railway drops at grades under the sidewalk to save room. The stations fortunately do not pair off, so that travel

FIG. 14.—MOVING SIDEWALK, TOP VIEW AND STATION, SHOWING GUIDES.

on the one system is independent of the other with less tendency to crowding. The two systems traverse the Quai d'Orsay, pass along the inner side of the Champ de Mars, run off a while from the Exposition entirely, along the Avenue de la Motte Picquet, and then come again to the Exposition precincts at the inner side of the Esplanade des Invalides. Consequently all the stations are concentrated at the three sides touching exhibition points and within the grounds. It could not well be otherwise under the circumstances. There are 14 stations, nine for the sidewalk and five for the third rail. Current is generated at the large Westinghouse traction power house in the suburbs at D'Issy-les-Molineaux, near Billancourt, and sent three-phase to a large transformer station at the junction of the Quai d'Orsay and the Avenue de la Bourdinnais, where the 5000-volt current is

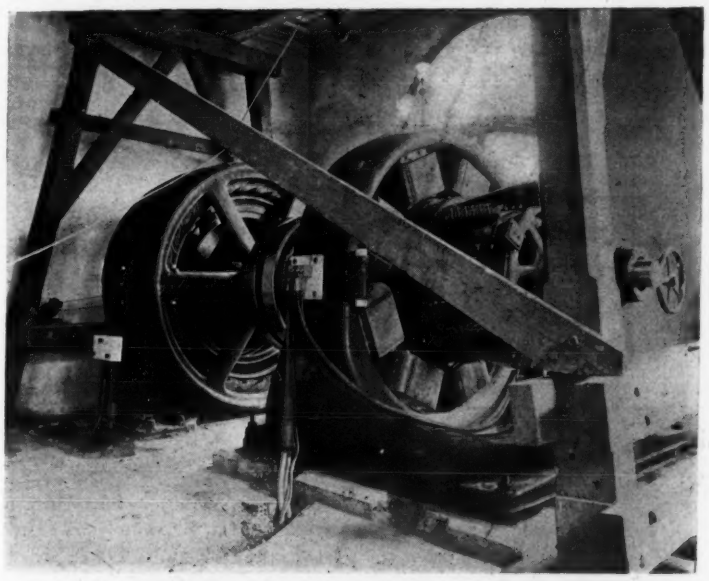

FIG. 15.—MOTOR GENERATOR UNIT FOR MOVING SIDEWALK.

stepped-down and rectified to direct. The Westinghouse apparatus for receiving the sidewalk current was briefly described in THE ELECTRICAL WORLD AND ENGINEER of March 3, 1900, and the operating system will come in for specific treatment later. It will suffice here to say, that the sidewalk is kept moving by 150 Westinghouse motors of 5 horse-power each at 500 volts, and will have a speed of 2¾ miles an hour for one walk and 5½ for the other, making the round trip in about half an hour. The exact carrying capacity does not so far appear. The third-rail, single-track road has capacity and rolling stock for 40 trains an hour at intervals of 90 seconds, seats and standing room being furnished on each for 206 persons. The speed will be not in excess of 4 miles an hour. The trains consist of a motor car and two trailers. At Chicago, it will be remembered, one of the electro-mechanical sensations was the 2000-hp General Electric generator, then viewed with so much pride and congratulation, as the biggest traction unit of its kind. When one looks at the colossi of to-day in

FIG. 16.—MOVING SIDEWALKS AND THIRD RAIL JUNCTION, AGRICULTURE BUILDING AND ECOLE MILITAIRE.

power plant, on the occidental side of the Atlantic, the dynamo art in America is seen to have advanced far in the intervening seven years, for such a unit there attracts no attention. Here, however, it would still be treated, as it was then, with great awe and admiration by the general public. The Chicago Intramural, it may be added for purposes of comparison, had 10 stations, 15 trains of 1 motor car and 3 trailers, with 3 spare motor cars; and it extended not in a circle, but in a winding unclosed oval with 14,800 ft. of double track and 1900 feet of single. It is said that to facilitate circulation the third-rail system will run in one direction and the moving sidewalk in the other. The sidewalk will run from right to left around the circuit, and the third-rail system from left to right. The sidewalk can be slowed down, and the two sections run separately if need be.

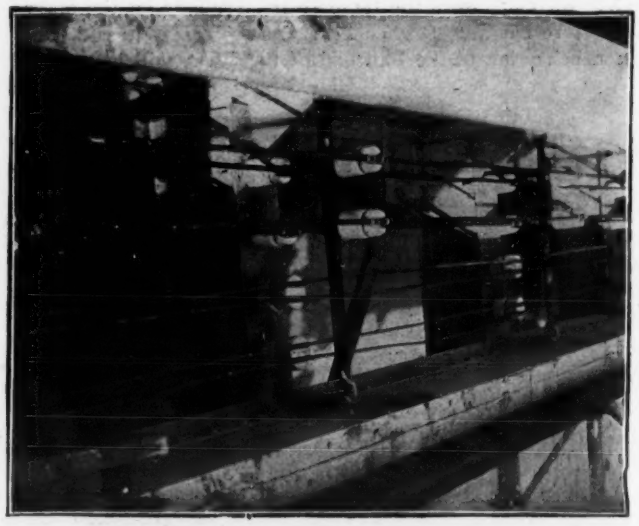

FIG. 17.—DETAIL OF MOVING SIDEWALK CONSTRUCTION WITH CIRCUITS.

It is one of the novel features of the sidewalk that its stations are to be reached by "escaladeurs," or moving stairways, of which also a large number are scattered about the different main buildings, to give access to the galleries, rendering those portions just as desirable and accessible as the ground floor. In fact, many exhibitors have preferred the galleries, and their visitors when going to see them will take a rest climbing the stairs. Of these escaladeurs there are some 27 or 28, all driven by electric motor. There will also be in operation some electric elevators, but obviously as all the upward vertical travel is to but one floor only, such elevators are really needless, and

do not get the opportunity to show off that is afforded them in a 30-story building on Broadway.

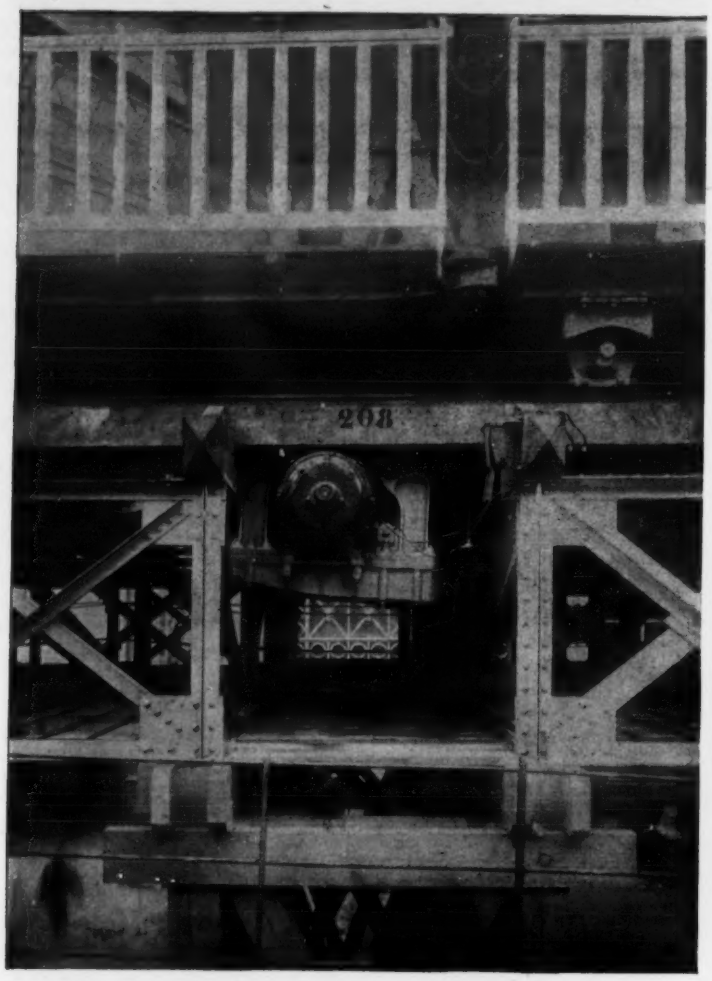

FIG. 21.—NO. 1 MOTOR OF MOVING SIDEWALK.

Additional to the transportation by the circular third-rail road, etc., there is a short but commodious third-rail surface and sunken road running independently the length of the Exposition, crosswise along the Quai d'Orsay, from the large steam terminus on the outer side this juncture has not been made very plain, but, it is said, that this adjunct, belonging to the Railroad of the West, will be operated by of the Champ de Mars to a similar terminus for steam lines on the

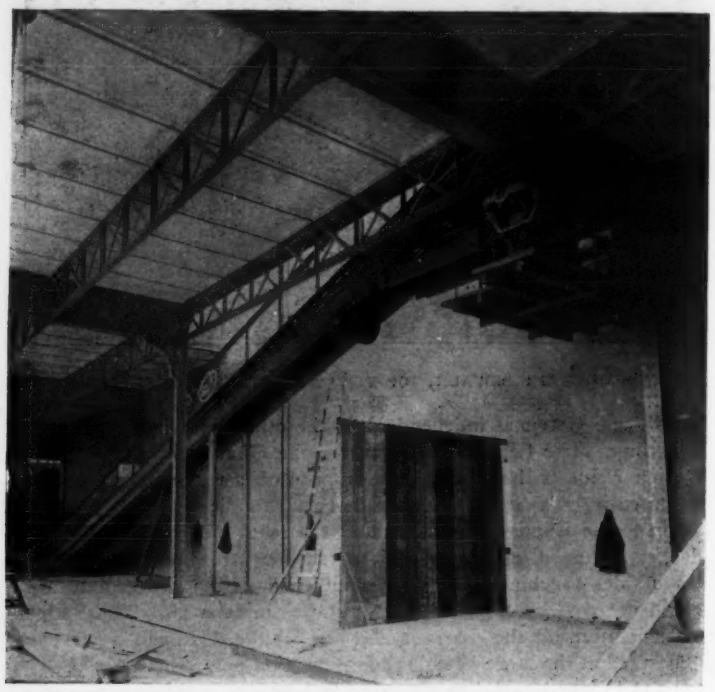

FIG. 22.—MOVING STAIRWAY. FRENCH ELECTRICAL SECTION.

outer side of the Esplanade des Invalides. The plan of operation at electric locomotives, although just now a steam locomotive is plying on it. The Champ de Mars depot for it is immediately adjoining the big Worthington pumping station. Current is already on the system, but no definite data can be secured as to the electric rolling stock, etc. The only plan available shows but one intermediate station along this line, which may perhaps be found later to be serviceable in affording locomotion for the opposite right bank, now without any visible mechanical means of traction. In other words, all the methods of transportation appear to be limited to the parts of the Exposition on the left bank of the Seine. There are, however, rolling chairs in profusion for those who do not or cannot walk—if they "have the price" for such accommodation. One great convenience at Chicago was the fleet of 50 electric launches, which carried over 1,000,000 people and were most useful in going from point to point. Here there are none, although there will probably be pleasure boats for hire on the river. On the whole, it will be seen that the Exposition is by means of electricity infinitely better served than was its predecessor by the mean little steam road of 1889.

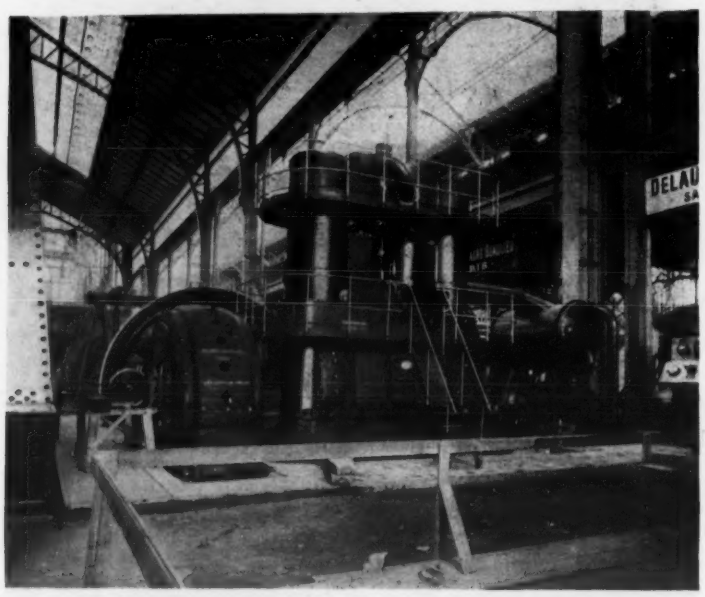

FIG. 23.—DIRECT-CONNECTED ENGINE AND DYNAMO, DELAUNAY-BELLEVILLE & CO., IN FRENCH POWER-HOUSE.

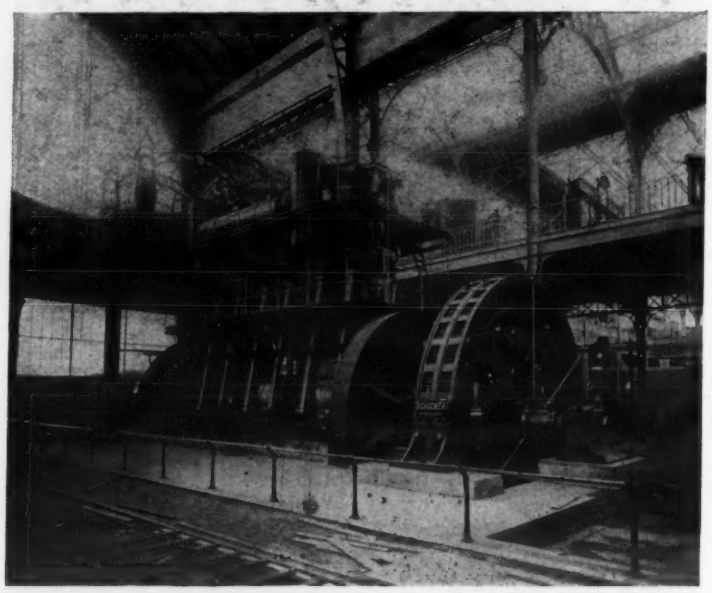

FIG. 24.—DIRECT-CONNECTED ENGINE AND DYNAMO OF NUREMBERG ENGINE CO. (SCHUCKERT), IN GERMAN SECTION.

THE VINCENNES ANNEX.

It was early found that there would not be space enough at the Champ de Mars for all the electrical, mechanical, engineering and transportation exhibits that offered. Director Francis E. Drake had

at his command when the time came for settling things seriously, only 48,000 sq. ft. for electricity and machinery, and found that the exhibits proposed would need three times as much. The officials of other countries were in the same dilemma, and dealt with it in various ways. The outcome for the United States was the securing of a special concession for a separate Machinery Building in the Bois de Vincennes, a beautiful park about 6½ miles from the Exhibition proper. There a triangular space of considerable area has been occupied by the building, and other special American exhibits in separate edifices, the building itself being no less that 346 ft. long and 127 ft. wide, exclusive of the power plant. Details have appeared in these pages as to the plans and work there, and at this stage of incompletion it is too early to recapitulate minutely or to describe. The power plant as planned prior to the loss of the "Pauillac" with so many fine American exhibits, was to include a 250-kw Bullock generator, with 300-hp Ball engine, and two 250-hp Morrin boilers; and this equipment is being duplicated and realized as closely as possible. The building itself is in structural steel by the Berlin Iron Bridge Company.

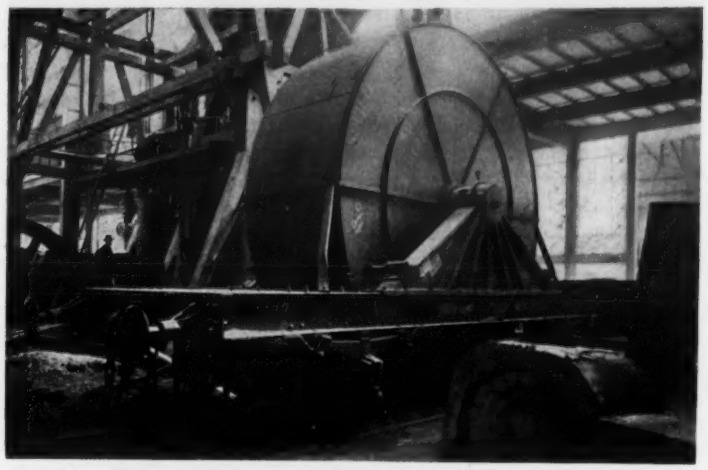

FIG. 25.—TRANSPORTING LARGE ARMATURE. FRENCH SECTION.

The display of transportation apparatus at Vincennes is fine and large, supplemented by that in many lines of machinery; and the Railroad Building there is a vast depot, on whose tracks exhibits have been run, the United States having over 20,000 ft. There is also an automobile and bicycle track. A misapprehension has existed to the effect that only American exhibitors had gone out to Vincennes. On the contrary, the displays there are those of all nations, and an area of about 175 acres is occupied.

SPECIAL ELECTRICAL FEATURES, ETC.

The descriptions given above have necessarily included reference to a great many special electrical features, though as many more have been passed over in present silence for obvious reasons, or by request. It takes time to get these things in shape, after the rush of mere installation is over, and it would have been criminal to open up to damp air, dust and clumsy workmen objects or constructions that require jealous guarding. There will be in Electricity Building a number of most interesting features, although it does not seem likely that they will equal in magnitude and brillance those of 1893—the lofty Edison Tower of Light, the Western Electric Scenic Theatre, the Westinghouse exhibit of polyphase apparatus, and the dark room where Tesla's tubes burst into light when waved in the surcharged air. But much of what was wisely made spectacular in 1893

FIG. 26.—FOREIGN SECTION, ELECTRICAL BUILDING, OPENING WEEK.

has passed into commonplace and could be seen on every street and facade the night of the opening of the present Exposition. This is the closing year of what has been for those who lived in it a wonderful century, and one idea at the exposition has been to gather up and recognize the work of the pioneers whose work has so crowded the one hundred years with benefits to mankind. There is thus a beautiful feature in Electricity Building at Paris that Chicago

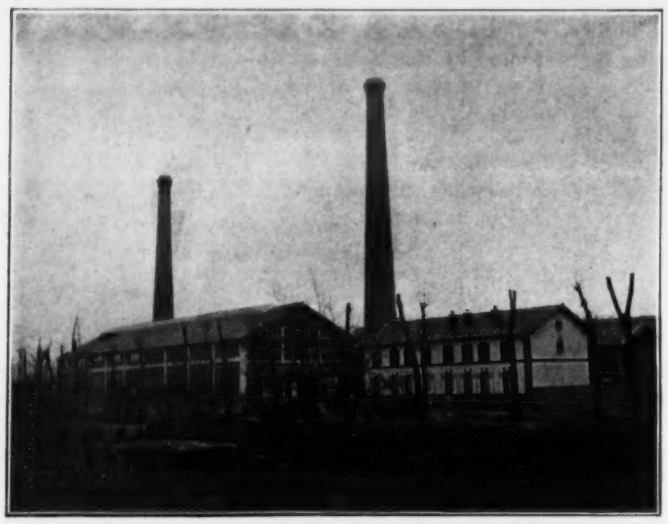

FIG. 27.—VIEW OF MOULINEAUX STATION FROM BRIDGE.

missed, namely a Salon d'Honueur, or temporary Pantheon, where relics of invention are grouped. It occupies a large part of the gallery just back of the Chateau d'Eau, and the Court of Honor of the United States has a superb position fronting right out over the foreign section of the main floor. Mr Drake has housed the collection in a structure of really classic beauty, and Mr. J. S. Anthony, Assistant Director, has ransacked the United States with the most intelligent zeal and enthusiasm for objects of real value and interest, his search resulting in many genuine treasure troves. The German, Swiss, French and other courts are equally important and interesting, and it is safe to predict that the savant and student, the engineer and the historian, will spend many hours in this charming section, through whose open windows can be seen the green lawns of the Champ de Mars esplanade, and through whose doors come the breeze and murmur from the cascading waters of the electric fountains.

There are, of course, many features of electrical interest due to exhibitors and concessionaires, such as the Luminous Palance, all built of glass, the Palace of Optics, panoramas driven by motor, moving pictures on a large scale of projection, etc. At the present there are more easily imagined than described, as it is hardly wise to depend on the preliminary programmes of their sanguine promoters. Most of them bid fair, however, to be quite successful. Even in Vieux Paris, where it is certainly to be least expected, one encounters electricity, and that marvelous little reproduction of the more famous streets and buildings of Lutetia of the past is not without its complement of arc lamps. It would, indeed, be wrong to condemn the visitor to an inspection of those winding lanes and picturesque halls by the lights that have failed in the years that are gone.

One of the minor pleasures of the closing weeks of the Paris Exposition of 1889 was to send from the third platform of the Eiffel Tower a telegram to your less fortunate friends informing them that with great intrepidity and safety you had scaled that fearful height of steel. Young married people honeymooning in Paris thought it very chic thus to send home word from the air that they office with its Hughes outfit was kept quite busy sending nearly had returned to earth and were very happy. The little telegraph 16,000 messages out for France and 5000 to the foreign parts that the "rastaquoeres" came from. The telegraph service of the Exposition as a whole, sent 47,514 telegrams for Paris, 30,000 for the provinces and 13,700 for abroad. The telephone service was, however, rather slim. Paris itself had not much of a network at that time, so that within the Exposition precincts there were but three telephone cabinets, all at the Champ de Mars, from which only 6421 calls were sent. In regard to telephony, therefore, Chicago marked a great stride, for the imposing classic temple of the American Bell Telephone Company in Electricity Building was a large and very busy exchange, employing a considerable force of operators.

This year, the Exposition is remarkably well equipped in regard to all these means of rapid intercommunication, and Mr. G. Serres, who has been specially delegated to this work by the Ministry of Postes and Telegraphs, to serve under Director-General Picard, has laid out his work on excellent lines. It is intended to have in operation no fewer than seven regular bureaux of Posts and Telegraphs in different sections of the Expositon; and telephone cabinets are being distributed throughout with a lavish hand. With regard to the cost of telephone service in the Exposition, the full charge for a regular installation by the department is $60 from Dec. 1, 1899, up to Dec. 20, 1900. This does not, however, include a free extra card for use of the pay stations. Cards of admission to these are issued separately and are good at all of them in the grounds to talk with any subscriber or pay station in Paris. They are good also between the dates above mentioned and the cost is $4. The subscription for a separate instrument in one's space can be taken for six months at $30, instead of the full year, and a charge of $2 is made for each separate instrument at a subscriber's station. Any month over the six can be paid for at the rate of $5.

This is all excellent but, Mr. Drake, Director of Machinery and Electricity, with the active aid and support of M. Mougeot, Under Secretary of State for the Department of Posts and Telegraphs, has "gone it one better," and has actually been able to install a 100-drop board of the latest central battery type, and of Western Electric make, it being set up and put in operation in the space of that company. Instruments for a large part of the capacity of the board will be put in various exhibits and there will be another board at Vincennes. M. Mougeot, who is a fine tyep of the rising man in politics and whose career Americans may some day watch with even more interest than now—has gone so far as to place three trunk lines at Mr. Drake's disposal, so that the service is not isolated, but is directly connected with that of France and the outside world. This is really a great concession, and makes M. Mougeot's courtesy to Americans in this matter deeply appreciated by the many who will benefit by it. Moreover, the installation is unique in being not only an illustration of latest American practice, but the only thing of

FIG. 28.—INTERIOR OF MOULINEAUX POWER STATION, SHOWING THREE GENERATORS AND ENGINES.

the kind in the Exposition. The Swedes have put in a small telephone system, but it is only for exhibitional use within the local small area of their own space.

Owing to the provision for telephony on so liberal a scale, that for telegraphy need not be so large, but there will be the bureaux already

mentioned, any one of which is within easy distance of the exhibitors in each section, and all of which will have a full staff. There is also a complete service for police and fire, and it may be noted that a fine guard under command of Capt. Bowen has been formed for purposes of patrol of the National Building and the various United States groups and annexes. Their uniform is a very dark blue with silver trimmings and dark peaked hats, or white helmets, as the occasion may require.

AUTOMOBILISM.

It is needless to say that in France, where the automobile art has enjoyed such a striking development in the last few years, great attention is being paid to the Exhibition display in this branch of industry. As already noted, the exhibit is at Vincennes, where the preparations are on a very elaborate scale, while a special appropriation of $25,000 has been made to carry out the programme of competitions, fetes, etc., due, it would seem, to M. Jeantaud, and to be executed under the auspices of the Automobile Club of France. The official committee is M. Forestier, inspector general of roads and bridges, as president; the Count de Dion, Maurice Binder and E. Sartiaux, vice-presidents, and Paul Meyau, secretary. The programme includes for the month of May a competition of touring vehicles, with daily runs of over 90 miles, for vehicles of 2 seats, 4 seats, 6 seats, and more than 6. For the month of June there is a trial of cabs and delivery wagons, extending over five days, and with a daily run in Paris of 37 miles.

FIG. 29.—INTERIOR OF MOULINEAUX STATION, SHOWING GENERATORS.

In July will come a great racing week, for all vehicles, in three classes, and including five big races of 185 to 250 miles, timing from Joinville. August will witness the brushes between the whizzing little voiturettes—now ubiquitous in Paris—limited to about 850 lbs. and carrying two persons. In September is the competition for lighter delivery wagons of the Gorham and Altman type in New York, and carrying about 220 lbs. Heavy vehicles are to be tested in October under strenuous conditions, in the classes for passengers and freight, there being five daily trials of 30 miles each. As already said, a special provision of $25,000 is to be made toward the competition expenses, the total cost being about $40,000, of which $15,000 will come back in entry fees, etc. It is understood that great preparations are being made by designers here for these events, but there is also reason to believe that more than one competitor will come from America, and that some of them will pin their colors to electricity. Even the above brief sketch, long as it is, of interesting races and tests, does not include others arranged or likely to occur, such as the New York *Herald* race across France. Among those mentioned at present as intending to compete for the James Gordon Bennett cup are Messrs. A. L. Riker, C. E. Woods and A. Winton; and the automobile clubs generally represented in the various races comprise those of France, America, Great Britain, Belgium, Italy and Germany. It is stated that a special charging station for the electrics is to be erected at the Bois de Vincennes, and that on the occasions of the races a large board will be used indicating the route, over which miniature little "mobiles" will be moved electrically to show the relative positions of the contestants. It is also reported that use of wireless telegraphy will be made for the same purpose.

On the lake at the Bois, a number of motor launches are expected, and there may be some contests, but no details are at present available, and electricity does not appear to be prominent. It will be a great pity if the convenience and economy of the electric launch cannot be demonstrated here, especially by charging from the same plant that feeds the automobiles.

CONGRESSES.

The readers of this journal are already familiar with the fact that a series of Congresses is to be held in connection with the Exposition. Indeed, no international affair of this kind is now complete without these opportunities to compare notes of advance, unify programmes of work, and suggest or adopt new standards of universal validity. Indeed, while it is quite possible that expositions of the present magnitude may come at much wider intervals apart in the new century, congresses will become more frequent. For Paris this year no fewer than 70 have been organized, and a splendid Conference Hall on the grounds has been provided for these and other affairs of the same character, extending from May into October. Of these congresses 12 are distinctively scientific, 6 relate to medicine and hygiene, 19 cover applied science and allied industries, 12 are devoted to education, and 21 embrace the wide area of sociology, social science, economics, etc. The electrical congress is listed for Aug. 18 to 25; physics, Aug. 6 to 11; street car traction, Sept. 10 to 12; steam engines and machinery, July 16 to 18; applied mechanics, July 19 to 25; applied chemistry, July 23 to 31. With regard to electricity, it may be said that the term of duration is merely provisional; and the remark of M. Mascart that barely a day or two would have to suffice is likely to be borne out, especially as there is a great demand for the use of Conference Hall. The committee or organization includes Mascart, president; Moissan, H. Fontaine and Gariel, vice-presidents; Janet and Sartiaux, secretaries; Violet, treasurer; general members, D'Arsonval, Berger, Blondel, Bonilhet, Carpentier, Darcq, Gosselin, Hillairet, Hospitalier, Joubert, Lippmann, Mazen, Meyer, Monnier, G. de Nerville, Pellat, V. Picou, Postel-Vinay, Potier, Sciama, Gen. Sebert, de la Touanne, J. Violle, Vivarez, E. Wunschendorf—a fine body, in short, of representative French physicists and engineers, many of whom have taken active part in previous electrical congresses. Those who wish to enroll as members of the congress should communicate before the opening with Mr. Paul Janet, the secretary of the committee of organization, 14 Rue de Stael, Paris, the fee being $4, which will cover also the report of the transactions.

Connected with the congress and immediately preceding it in the same week, will come the joint meeting of the American Institute of Electrical Engineers and the English Institution of Electrical Engineers. Committees of these two bodies have worked out a plan and have actually had a joint session already. To American electrical engineers passing through England at the time, hospitalities will be extended, and special arrangements are being made as to trains, boats, etc. It is proposed, if possible, to have the joint meeting in the American National Building in the morning and to attend a reception the same evening in the British Building, both on the "Street of Nations," in the grounds. These two sessions will comprise the regular functions, it being believed that with an impending congress, with hot weather, and with all the attractions of the exhibition around, members will be quite satisfied with so modest a programme of work.

It is worthy of note that supplementary to and underlying all this general congress work in Paris, it is proposed to seize the opportunity to found an International Association for the Advancement of Science, Arts and Education and to hold the first meeting during the summer. The French and English have had for some time two influential committees for this movement, and Prof. P. Geddes, secretary of the English section, was in the United States this spring organizing American sentiment in its favor, particularly in the universities and colleges. A large scheme of academic and educational work has been laid out and a great many teachers and students are deeply interested in watching the results. Mr. Leon Bourgeois, recently French Minister of Education and a representative at the Hague Peace Conference, is president.

GENERAL NOTES.

In the scheme of Exposition classification, mechanical apparatus and appliances are included in Group 4 under 4 classes. Electricity

constitutes Group 5, with 5 classes. Civil Engineering and Transportation belong to Group 6, with 7 classes. Chemistry is Group 14, with 5 classes. Group 3 also includes instruments and general methods of letters, sciences and arts. There is an elaborate code of regulations, of which Chapter 9 applies to diplomas and awards, and the formation of the international juries. For all the class, the total number of French or foreign appointed jurors is to be about one-sixtieth of the total number of exhibitors. There will be juries of groups and a high jury, and it would appear that great care will be exercised in selecting good men, some of the requirements as to status and calibre being quite specific. Awards will take the nature of grand prize diplomas; gold medal diplomas, silver medal diplomas, bronze medal diplomas and honorable mention diplomas.

According to present figures, due to Mr. C. H. Simms, the assistant director of Liberal Arts, etc., the United States has the official record of 7000 exhibitors, over three times as many as any other foreign country and three times as many as France sent to Chicago. Indeed, the remarkable fact thus comes out that the United States stands next to France herself in number of exhibitors, despite the intervening 3000 miles of ocean. Americans exhibit in every one of the 18 groups and there are 47 distinct American exhibit spaces or sections occupying 329,052 sq. ft.; 33 of these spaces being in the main grounds and 14 at Vincennes. In addition to all this, there is the beautiful national building or pavilion in the Street of Nations on the Quai d'Orsay. This is a most creditable showing, but, after all, it has to be done if America is to get her share of the world's trade and to ascertain how she sizes up alongside her competitors. Recent events have turned eyes in her direction, not altogether with admiration at times, and she is now to prove her skill in the arts of peace, the only arts really worthy of her efforts and the only ones truly embodying her principles and her ideals.

MACHINERY AND TRANSPORTATION AT VINCENNES.

It has now been arranged by Director Drake that the American Machinery Building shall open on May 10, when the exercises will be of an interesting nature and assisted by Sousa's Band. Exhibits are now pouring in steadily, and those sent over to look after them, instead of rushing desperately to Havre or sitting around with other unfortunates in a group swapping stories till the cases arrive, are busy getting things into shape. This building is, indeed, as compared with any other in the Bois, remarkably advanced, only that for Transportation comparing with it, but hardly on equal terms, the latter being a large train shed into which locomotives and cars have been run directly from the regular railroad tracks.

A number of the exhibits are also ready for inspection, although the crowd has not yet found its way for exhibition purposes to this popular and not generally fashionable resort of workaday Paris. Steam has been up for some days in the Morrin boilers, all of the 250-hp units supplying steam for the temporary generating plant; the Shaw electric 25-ton crane has at last been put into operation, and the Ingersoll-Sergeant Drill Company's compressor plant awaits anybody's request for compressed air, whether it be tools or brakes. Mr. Fred F. Smith, of the Ferracute Machine Company, has not only organized his exhibit there in Block 5, of heavy apparatus, but has another in the main American machinery exhibit on the Champ de Mars, and has a fine coining plant in the United States Government exhibit at the same part of the Exposition. These machines being shown in many instances in connection with Crocker-Wheeler and Triumph motors, and some of them being illustrative of armature disc cutting, etc., are of unusual interest to electrical engineers.

In the Transportation Building, one interesting exhibit already installed is that of the motor car in use on the Budapest underground road. To the New Yorker, this chance to study the methods adopted will prove particularly welcome at this time, when his own city is preparing to resort to a similar system of traction. In this car the body overhangs a motor at each end in order to secure a minimum height, without reduction of seating capacity.

EXPOSITION NOTES.

Mr. H. Ward Leonard, who has been traveling in Europe with his wife, has reached Paris and is giving attention to the arrangement of an exhibit of the products of his company in resistances, etc.

Mr. J. H. McGraw arrived in England by the Kaiser Wilhelm der Grosse on April 18 and is expected in Paris by April 29.

Mr. J. S. Anthony, assistant director in the Department of Machinery and Electricity, has recovered from a dangerous attack of grip brought on by overwork, and is putting the last touches on the Salon D'Honueur, with a large force of experts and workmen.

The American Guards are now on duty, and it is a relief to exhibitors in the mechanical and electrical sections to get frequent glimpses of their neat uniforms, brightening up the otherwise rather forlorn perspective.

Tons of Apparatus have begun to pour in again. It is stated that some 28,000 tons of exhibits were sent in before cars were barred out in order to prepare for the opening exercises, and the estimate is that 10,000 tons more have been dumped down in the week ending April 28. Every siding on the railroads around Paris can be seen lined up with loaded cars of material labeled for the Exposition, including many pieces of machinery and tools. The work of unpacking has resulted in a great deal of renewed dust, noise and confusion.

Steam was raised on April 19 in the French section of the power plant, and next day in the foreign section. So far no lights have been energized from the plant, current being drawn from outside sources. But it is officially announced that the first night fete will occur April 28, when a large number of lights will be switched on from the service dynamos, some of which are quite ready.

The Eiffel Tower is a beautiful spectacle when outlined at night by incandescents, with a large arc at its very crest. It has had a plant in the base of one of its huge feet, but this is now being greatly enlarged for spectacular effects, etc. The lamps which go up to the crest on all sides, nearly 1000 feet in the air, are on the two-wire system, direct current, 110 volts. In spite of the difficulty of maintaining insulation under such exposed conditions, the circuits remain intact with great precision, as a rule, and few lamps burn out or are broken by windshock, etc.

Inductive E. M. F. in Transformers.

By John B. Whitehead, Jr.

VARIOUS terms and definitions have been used to denote the counter e. m. fs. of self-induction due to magnetic leakage in the transformer, and frequent explanations given of their effect upon regulation. The cause of the existing confusion seems to lie in the presence of two e. m. fs., one in each coil; and in the difficulty in expressing their joint effect in the primary circuit. In what follows another attempt will be made to explain the influence of magnetic leakage on regulation, how a single measurement can give the joint effect of both e. m. fs. in any given transformer, and also how this joint effect may be calculated from the dimensions.

It is now well understood that owing to the passage or leakage of lines of force across the coil space from one part of the magnetic circuit to another, each coil, primary or secondary, is surrounded or encircled by a number of lines which do not pass through the other; furthermore, this effect increases with the currents in the coils and is a maximum at full load, which is the condition we will presuppose in this discussion.

Consider the case of a simple two-coil transformer with closed magnetic circuit, and coils in parallel position, that is side by side (Fig. 1); the primary and secondary currents are practically in opposition to each other, differing from the 180° relation only by the small angle which causes their resultant to be the magnetizing current of the main core flux surrounding both coils. But while practically neutralizing each other so far as the core is concerned, it will be noted that the two m. m. fs. due to the ampere turns in the two coils, work together or in multiple to cause leakage lines through the air space between the two coils. The result is a field strongest at the centre and falling off towards the outer edges of the coils, as indicated by the dotted lines; this field is made up of two separate leakage fluxes, one passing around each coil and so inducing a counter e. m. f. in that coil alone. Or in each coil an e. m. f. is induced 90 degrees behind its leakage flux, and so 90 degrees behind the current in the coil.

The influence of these e. m. fs. on the regulation of the transformer depends on the phase relation of the secondary e. m. f. and current, that is, on the power factor of the load. This dependence may be seen in any of the numerous transformer diagrams published, among the clearest of which is that due to Steinmetz (Alternating Current Phenomena), and which is reproduced in Fig. 2. Rotation is clockwise, and the main core flux $O\Phi$ is conveniently taken as the vertical line; then 90 degrees behind $O\Phi$ is Oe', the secondary induced e. m. f.; OF_1 is the secondary current lagging be-

hind Oe' by B the secondary angle of lag; 90° behind OF_1 is Oe_{x_2}, the counter e. m. f. due to magnetic leakage in the secondary coil, and 180° from OF is Oe_r, the C R drop in the secondary considered as a counter e. m. f.

The resultant of Oe_x and Oe_r is Oe_z, which combined with Oe' gives Oe_1 the secondary terminal e. m. f. OF is the magnetizing current leading $O\emptyset$ by the angle of hysteretic advance, and is the resultant of OF_1 and OF_0 the primary current; 90° and 180° behind OF_0 are e. m. fs. due to leakage and CR drop; these two e. m. fs. must be overcome by components of the impressed primary e. m. f., and the resultant of these two components is OE_z; a further component of the impressed e. m. f. must overcome the counter e. m. f. in the primary coil due to the main flux; this component is OE', and OE_0, the resultant of OE' and OE_z is the primary impressed e. m. f.

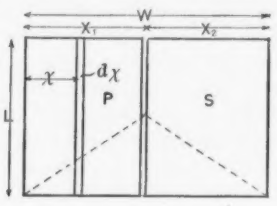

Fig. 1.

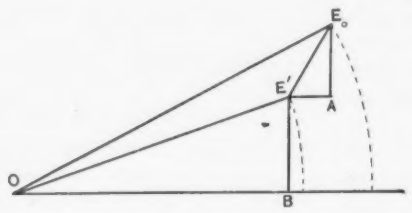

Fig. 4.

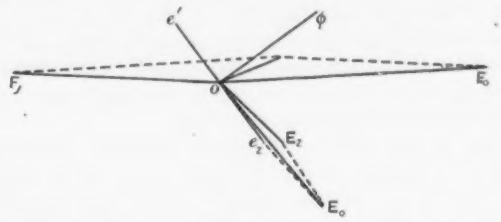

Fig. 5.

Supposing for simplicity that the ratio of transformation is one to one, then the drop in the transformer is the difference between E_0 and e_1; the magnitude of this difference depends on the values and positions of these two lines Oe_z and OE_z, that is, on the values of the leakage e. m. fs. Oe_x and OE_x and on the power factor of the load which determines the angle a. We have for the present combined in each coil the inductive or leakage e. m. f. and the ohmic e. m. f.;

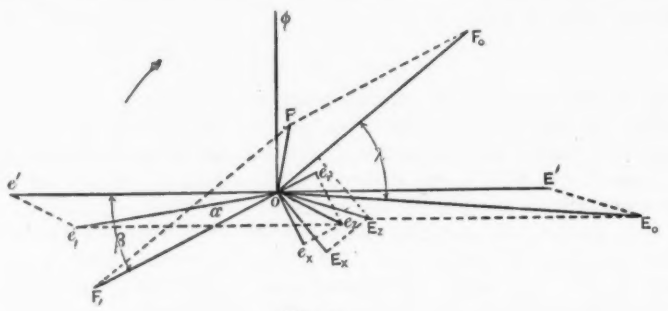

Fig. 2.

since each e. m. f. affects the regulation we will consider their resultant and term it the e. m. f. of internal impedance.

Looking at Fig. 2 we notice that the two lines Oe_z and OE_z, the e. m. fs. of internal impedance in the two coils, very nearly coincide, only differing in phase by the small departure from the 180° relation of the primary and secondary currents. If now we imagine that

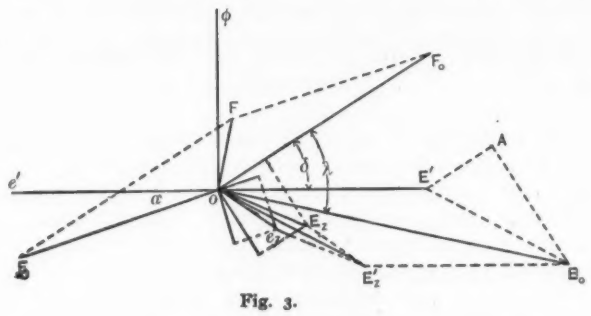

Fig. 3.

both these e. m. fs. exist in one coil, say, the primary, and so that there is no e. m. f. of internal impedance in the secondary, the full internal impedance e. m. f. will then be their resultant which is approximately their sum, considered to exist only in the primary circuit. While the secondary internal impedance e. m. f. exists only in the secondary coil, if we thus consider it reduced to the primary coil, as is possible with other e. m. fs., by the ratio of transformation (here one to one) we can obtain a simple method for determining the regulation as affected by both ohmic and inductive or leakage e. m. fs.

The diagram now becomes that of Fig. 3; e' is now to be considered as the secondary terminal e. m. f. e_1; E'_z is the resultant of the two e. m. fs. of internal impedance, existing only in the primary coil, there being no effect in the secondary; a is the angle of lag in the load in both figures; λ the primary angle of lag will be approximately the same in both figures, and finally the difference between E_0 and e_1, that is, the drop in Fig. 2, is approximately equal to that between E_0 and e' in Fig. 3.

Fig. 3 does not represent any existing state of affairs, but is useful as a diagram to explain how the regulation may be determined; for OE', equal to Oe', is the e. m. f. on the load; the angle δ is approximately equal to a, which is determined by the power factor of the load, so that if the length and direction of the line $E'E_0$ is known, the drop in the transformer, that is, the difference between E_0 and E' can be at once determined. $E'E_0$ is the resultant of the ohmic and inductive e. m. fs.; the ohmic e. m. f. is known for a given transformer, and in Fig. 3 it may be laid off parallel to the primary current as the line $E'A$ and the length of $E'E_0$ will then determine the triangle $E'E_0A$, and so the direction of $E'E_0$; a method for measuring $E'E_0$ is given below.

Thus from Fig. 3 may be taken the diagram, reproduced in Fig. 4, given by C. F. Scott (paper before the Nat. Elec. Light Asso'n, March 1, 1894), for figuring the inductive drop in transformers, where OE' the e. m. f. on the load may be taken as 100 and all the other lines expressed in per cent. of OE'; OB is then the power factor of the load, $E'A$ the total ohmic drop in the transformer, $E'E_0$ the impedance e. m. f., $A'O'_0$ the inductive e. m. f. all in per cent. of the load e. m. f.; OE_0, the impressed e. m. f., is thus read in per cent. of the load e. m. f., and so permits easy reversal to an expression of drop in per cent. of impressed e. m. f.

This diagram was also used by Mr. Scott for problems of line regulation, and lately by C. P. Poole[1] for the same purpose. Also in Baum's method,[2] his line E_3 is the line OE', and his triangle bfg the triangle $E'E_0A$. These methods are sufficiently accurate but depend on the assumption that the resultant of the two leakage e. m. fs. considered in one coil represents their joint effect—that is, that the drop is the same in both Fig. 2 and Fig. 3.

To apply this method we must know the value of the resultant internal impedance e. m. f., i. e., the line $E'E_0$; this can be measured by short circuiting the secondary coil and impressing just so much e. m. f. on the primary coil as will cause the normal full load currents to flow in the two coils; this e. m. f. will be the line OE'_z in Fig. 3. The explanation of this measurement is as follows: In Fig. 5 let OF_1

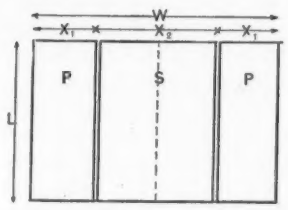

Fig. 6.

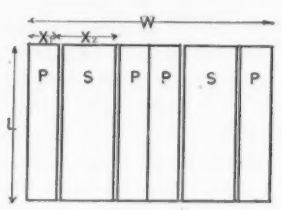

Fig. 7.

be the secondary current, then Oe_z is the e. m. f. of internal secondary impedance; now, as before, the terminal e. m, f. is the resultant e. m. f. of Oe_z and the induced e. m. f. due to the main core flux; but since the secondary is short circuited its terminal e. m. f. is zero, and therefore the induced e. m. f. is equal and opposite to Oe_z or is Oe'; the inducing flux $O\emptyset$ is 90° ahead of Oe', and, as before, the primary current is OF_0. OE_z is the component of impressed primary e. m. f. necessary to overcome the internal

[1] ELECTRICAL WORLD AND ENGINEER, Feb. 21, 1900.
[2] ELECTRICAL WORLD AND ENGINEER, Jan. 13, 1900.

primary impedance, and there is also induced in the primary an e. m. f. equal to Oe' (ratio one to one); to overcome this there must be a component of primary e. m. f. equal and opposite to Oe', and so coincident with and equal to Oe_2, the e. m. f. of internal secondary impedance; hence the necessary impressed primary e. m. f., when the secondary is short circuited, to cause full load currents to flow, is the resultant of these two, OE_0, which equals $E'E_0$ in Fig. 3—i. e., of the full load values of the two e. m. fs. of internal impedance.

The total ohmic drop may be calculated, and so the whole triangle $E'E_0A$, Fig. 3, is determined; the inductive e. m. f. proper is the line AE_0; it is hardly necessary to add that the values of the inductive and ohmic e. m. fs. are much exaggerated in the figures.

The value of the inductive e. m. f. may be approximately estimated from the dimensions of the transformer; this has been done by Jackson and others, but the difficulty here, as in all leakage problems, is the determination of the reluctance of the leakage paths. Let us investigate the effect on the inductive e. m. f. of an increasing subdivision of the primary and secondary coils; for the purposes of comparison we may consider the ideal case of a transformer whose insulation occupies no space.

First, in the case of the simple two-coil transformer, with coils parallel to each other, shown in Fig. 1, L is the depth of each coil, X_1 and X_2 the widths of primary and secondary, and $W = X_1 + X_2$ is the total width of wire space; the length of the built-up laminations of iron is $\frac{l_1}{2}$ or the length of each coil inside the core is l_1; similarly the mean length outside the iron on the two ends is l_2 for each coil; the turns in the two coils are n_1 and n_2, the currents i_1 and i_2.

Since each coil is surrounded on three sides by the iron, the leakage lines all pass across the coil, and we may neglect the reluctance of the part of their paths which lies in the iron; the induction is greatest in the plane of separation of the two coils where the full number of ampere turns in each coil is active, but the turns lying along the outer edge next the iron embrace the greatest number of lines.

Let us find the average value of the flux for the whole number of turns in the primary coil:

Aepmre turns at $x = \frac{x}{X_1} n_1 i_1$.

Maximum flux through the area $ldx = \sqrt{2}\ \frac{4\pi}{10}\ \frac{x}{X_1}\ n_1 i_1 \frac{ldx}{L}$

Average value of $\mathfrak{B}$ the induction, in the space from x to X_1

$$= \frac{1}{X_1 - x} \cdot \frac{1.76\, n_1 i_1 l}{L} \int_x^{X_1} \frac{x}{X_1}\, dx$$

$$= 1.76 \frac{n_1 i_1 l}{2L}, \text{ when } x = 0.$$

Therefore the flux Φ inducing e. m. f. in all the turns n_1 has the value $1.76\ \frac{n_1 i_1 l_1 X_1}{2L}$ for the total length of coil in iron l_1. The e. m. f. in the primary coil due to this flux is thus:

$$e_1 = \sqrt{2}\,\pi\,\Phi\, n_1\, N\, 10^{-8}$$

$$= 3.92\, n_1^2\, i_1\, N\, \frac{l_1 X_1}{L}\, 10^{-8}.$$

This is the e. m. f. induced in that part of the coil which is within the iron of the coil; there is also a considerable number of leakage lines surrounding the projecting ends of the coils. It is impossible to state the exact reluctance of the paths of these lines, but in general their lengths will be somewhat over twice that of those within the coil and their area also somewhat larger, so that we may take the reluctance per unit of length on the ends to be approximately twice that within the core. Adding the effect of this flux to that of the leakage flux within the core we have for the e. m. f. due to leakage in the primary:

$$e_1 = 3.92\, n_1^2\, i_1\, N \frac{l_1 + .5\, l_2}{L} X_1\, 10^{-8}.$$

A similar e. m. f. exists in the secondary:

$$a\, e_2 = 3.92\, n_2^2\, i_2\, N \frac{l_1 + .5\, l_2}{L} X_2\, 10^{-8};$$

reducing this to the primary by the ratio of turns a.

$$a\, e_2 = e'_2 = 3.92\ a\, n_2^2\, i_2\, N \frac{l_1 + .5\, l_2}{L} X_2\, 10^{-8}$$

$$= 3.92\, n_1^2\, i_1\, N \frac{l_1 + .5\, l_2}{L} X_2\, 10^{-8},$$

adding e_1 and e_2', as explained above, we have the total inductive e. m. f. for the two-coil transformer:

$$e_t = e_1 + e_2' = 3.92\, n_1^2\, i_1\, N \frac{l_1 + .5\, l_2}{L} W\, 10^{-8}.$$

Consider now the case shown in Fig. 6, the secondary placed between two primaries. By the method given the e. m. f. in each primary is:

$$e_1 = 3.92\ \frac{n_1^2}{4}\, i_1\, N \frac{l_1 + .5\, l_2}{L} X_1\, 10^{-8}.$$

The secondary in this case is subject to conditions different from those in Fig. 1; the coil lies away from the iron so that its leakage paths are now symmetrical about a central line, and their length in air is twice as great; an investigation like that given above gives the value of the e. m. f. as:

$$e'_2 = 3.92\, n_1^2\, i_1\, N \frac{l_1 + .5\, l_2}{4L} X_2\, 10^{-8},$$

the total inductive e. m. f. is then

$$e_t = 2\, e_1 + e'_2 = 3.92\, n'_2\, i_1\, \Lambda \frac{l_1 + .5\, l_2}{4L} W\, 10^{-8},$$

or only one-fourth that of the two-coil arrangement.

A further subdivision of coils is shown in Fig. 7, where the primary is in four parts and secondary in two, each secondary being between two primaries. The e. m. f. in each outside primary is as before:

$$e_1' = 3.92\ \frac{n_1^2}{16}\ i_1\, N \frac{l_1 + 5\, l_2}{L} X_1$$

in the two central primaries together:

$$e_1'' = 3.92 \frac{n_1^2}{4} i_1\ N \frac{l_1 + .5\ l_2}{4L} \cdot 2\ X_1\ 10^{-8}$$

and in each secondary

$$e'_2 = 3.92\ \frac{n_1^2}{4}\, i_1\ N \frac{l_1 + .5\, l_2}{4L} X_2\, 10^{-8};$$

the total effect is then

$$e_t = 2\, e'_2 + e_1'' + 2\, e'_2 = 3.92\, n_1^2\, i_1\, N \frac{l_1 + .5\, l_2}{16\, L} W\, 10^{-8};$$

or one-sixteenth of that of the two-coil arrangement.

The rule may then be stated that if the secondary is in half as many parts as the primary and each part between two primary parts, the inductive e. m. f. varies inversely as the square of the number of parts into which the primary is divided.

If the primary and secondary are divided into the same number of parts and they are placed alternately, the inductive e. m. f. is decreased with increasing subdivision approximately but not exactly with the inverse square of the number of subdivisions of either coil.

Owing to the fact that there is always an appreciable space between coils occupied by insulation, and over this space the total m. m. f. is active, values calculated by the above given formulæ will always fall short of actually measured values. While it is obviously impossible to set a definite ratio for this difference, the writer has found that the measured values of inductive e. m. f. on a large number of transformers of the type shown in Fig. 7 are approximately twice those calculated by the formula given above.

A New Generating Unit for the Chicago Edison Company.

The Chicago Edison Company will install next year in its Harrison Street station in Chicago the largest generating set ever built for direct current Edison service, as well as the largest double-current machine ever constructed. The unit will contain one dynamo, rated at 2500 kilowatts, capable of delivering from its commutator the full pressure between positive and negative bus-bars, or about 240 volts. From collector rings the same winding will deliver three-phase currents for transformation up to the 4500 volts pressure of the company's high-tension transmission lines. The machine will have 40 poles and run at 75 r. p. m. giving, therefore, 25 cycles, and will be worked in parallel on the alternating as well as on the direct current end with the present double-current sets, which consist of two three-wire units, each containing two 200-kw generators. On account of the size and the consequent thermal storage capacity of its parts, the new unit will have a large overload capacity for short periods, a valuable feature in service with a sharply defined load peak. This machine can probably be readily worked up to a 40 per cent overload for one hour without risk of overheating.

The Indications of Commercial Instruments on Wehnelt Interrupter Circuits.

BY GEORGE T. HANCHETT.

EVER since the advent of the Wehnelt interrupter the writer has, no doubt in common with many others interested, desired to know the relative divisions of energy between the various parts of the circuit, the character of the interrupter current wave, and various other matters of importance in investigating the action of the device.

The first attempts very naturally consisted of connecting direct-current instruments in the circuits, which gave indications of a most astonishing character. These led to still further investigation with other instruments which the results seemed to indicate were better suited.

In the aggregate, the measurements which are discussed beyond, while interesting are not very satisfactory, but the writer believes that they throw a little light on the subject and are perhaps valuable in indicating what methods should not be employed, and in pointing out the alternatives.

The circuit which was used in these tests was supplied at constant direct-current potential, and consisted of a Wehnelt interrupter, an inductive section consisting of the primary of an induction coil, and a practically non-inductive adjustable resistance inserted for the purpose of controlling the current. If in such a circuit a direct-current ammeter was connected, a steady deflection was noted, and as far as the instrument itself was concerned, it behaved as though it was measuring the current flowing through a simple resistance. If such a circuit is supplied at constant potential, the line voltage will be practically undisturbed by the Wehnelt circuit, with the possible exception of a slight drop such as would be caused by the drawing of any current from the tap circuit. If we use a direct-current Weston voltmeter and take the potential around the various parts of the circuit, we shall find that Ohm's law is roughly followed about every portion of the circuit, especially those which are non-inductive. The sum of these various potentials equals the main line potential, facts which tend to reassure the observer as to the accuracy of the measurements.

To take a concrete case the writer observed on such a circuit as has been described the following measurements:

Current measured by direct-current ammeter	7.75
Volts around coil measured by direct-current voltmeter	3.
Volts around interrupter measured by direct-current voltmeter	60.
Volts around rheostat measured by direct-current voltmeter	34.5
Main line volts	100.5
Sum of potential around various parts of the circuit	97.5

Ohm's law was practically followed in every case, the resistance of the various portions of the circuit measuring as follows:

Resistance of interrupter, ohms	4.55
Resistance of coil, ohms	.305
Resistance of rheostat, ohms	4.8

Inasmuch as the dynamo regulation was not very good, but was inclined to fluctuate a volt or two, and some time was consumed in taking the readings, these results were satisfactory. On investigating such literature as was to be had onthe subject of the indications of direct-current instruments on pulsating circuits, the writer seemed to concur that such instruments averaged the pulsation in cases both of current and voltage. The conclusions therefore were that the interrupter absorbed the major part of the energy, the coil itself very little, and the non-inductive resistance a greater amount, and all approximately according to the volt-amperes. The interrupter got very hot and seemed to bear out the conclusion that a great deal of energy was expended in heating its liquid contents.

The writer next attempted to connect a 100-volt lamp across the coil terminals, around which the direct-current voltmeter indicated a fall of optential of three volts. The lamp lighted up to considerably over full candle-power and burned with great brilliancy, and with a voltmeter indicating three volts at its terminals, the result to say the least was a little disconcerting. In connecting the lamp around the interrupter which indicated 60 volts, the lamp promptly burned out—another fact which caused the writer to lose faith in the indications of direct-current instruments on such a circuit.

The writer next procured a voltmeter built on the dynamometer plan and intended either for direct or alternating currents. Connecting this instrument around the coil, the voltage was found to be not 3 but 123. On connecting it around the interrupter the voltmeter indicated not 60 but 145, and around the presumably non-inductive resistance the indicated voltage was 38 as opposed to 34.5. On taking the instruments off the Wehnelt circuit and comparing them on direct-current circuits, they checked closely all over their entire scales.

The great brilliancy of the lamps seemed to verify the alternating-hurrent voltmeter indications. The fact that the direct-current voltages added up to the total, which was not true of the intications of the alternating instrument, was an item in the favor of the direct-current readings. The magnitode of the indications of the alternating instrument and the behavior of the lamps on the circuit clearly showed that there was two alternating electromotive forces, one around the interrupter and one around the coil, which were out of phase with each other and which the direct-current instrument failed to take account of.

Repeating the measurements with the alternating-current instrument and keeping the lamp in multiple with the voltmeter, it was found that it made little difference whether the lamp was turned on or not, the potential fell away very little. When the lamp was on, the potential was perhaps two or three volts lower than when it was off. The pitch of the interrupter, however, rose notably after the lamp was turned on. Removing the alternating-current voltmeter from the circuit and placing a spark gap around the interrupter, it was found that distances of one-quarter of an inch were easily jumped and that in one case a gutta percha wire covering one-eighth of an inch thick was punctured, a performance beyond the capabilities of 145 volts either alternating or direct. This performance led the writer to infer that there were long jagged peaks in the electromotive force curve taken around the interrupter terminals, and that the instantaneous maximum was bar above the readings of the alternating-current voltmeter. The potential around the coil exhibited similar jumping spark properties, but to a lesser degree.

In order to obtain further light upon the subject, the writer procured the following instruments and made with them as far as possible a series of simultaneous measurements. First, the potential around the various parts of the circuit was taken with a direct-current voltmeter; at the same time the above measurements were also taken with an alternating-current voltmeter. Simultaneously with the above readings the watts were measured around the various parts of the circuit with an alternating-current wattmeter of the Thomson inclined coil type. The current in the circuit was measured with a direct-current ammeter. The resistance of the coil and the non-inductive adjustable resistance were measured with a direct-reading ohmeter. The results are tagulated below.

The lowest scale division on both the direct and alternating-current voltmeter was one volt, and measurements involving fractional parts of a volt are of course estimated. Moreover, liberal allowance must be made for error in the case of small deflections. Similar considerations must be extended to the interpretation of the reading of the wattmeter, the smallest scale division of that instrument being 25 watts. The ammeter indicated on its smallest scale division single amperes.

The method employed was as follows: The ammeter and the series circuit of the wattmeter were conncted in the circuit. The potential circuit of the wattmeter and the two voltmeter circuits were multiplied together and carried off to a common flexible connection. Various points of the circuit at which the potential was to be taken were brought up to conveniently arranged mercury cups in a board. The main circuit was closed, the optential leads inserted in a suitable pair of cups, and simultaneous readings were made of the four instruments by four different individuals. The potential circuit was then changed to include a different portion of the main circuit and other readings made, and in that way the entire run of readings were secured.

In the accompanying table the first three tests were made with an interrupter of as low frequency as would work conveniently. The current varied considerably, due to the heating of the interrupter and the irregularity of the voltage of supply, and this threw an error into all results which depend upon simultaneous measurements. The next two tests were made on an interrupter of moderate frequency, the potential and current conditions being more steady. The last test was made on an interrupter of very high frequency, so high indeed that additional inductance had to be supplied in the circuit before it would work.

It was noted, as has been before mentioned, that there was a considerable amount of static charge in the Wehnelt circuit. It is possible that some error was thrown into the readings by reason of the

moving parts of the instrument becoming electro-statically charged and thereby being repelled or attracted by stationary portions of the instrument carrying opposite or induced charges.

In inspecting the above table the following facts will be found to be apparent: The line volts measured either by the alternating or direct-current instrument check practically in every instance, due consideration being had for the fact that the line voltage varies slightly. The observed watts on any adjacent sections of the circuit add up approximately to the watts observed around the sections as a unit, due allowance being had for the fact that the current conditions were varying and that simultaneous readings were impossible. The fact that both voltmeter and wattmeter had to be shifted from circuit to circuit may reconcile the discrepancy. The row entitled "Watts computed from D. C. readings, total," represents the current multiplied by the total volts, and nearly equals the sum of the calculated

AC = indications of AC instrument. DC = indications of DC instrument. K = Coil, I = Interrupter. R = Rheostat. See sketch. Character of measurement.	Interrupter 1, Low frequency.			Interrupter 2, Moderate frequency.		Interrupter 3, High frequency.
DC amperes.....	7	7.75	7.75	2.5	3.25	.5
DC volts I.....	23	42.5	60	67	70.5	101.5
AC volts I.....	51	108.75	145	137	145	137
Watts observed I...	137	187	237	75	85	10
Watts calc. from DC readings I.....	161	329	465	167	229	50.7
DC volts K.....	3	3	3	1.5	1.5	.5
AC volts K.....	53	94	123	108	117	25
Watts observed K..	50	110	168	95	112	25
Watts calc. from DC readings K.....	21	23	23	3.7	4.9	.25
DC volts around I and K.....	27	45	64	67.5	75	101.5
AC volts around I and K.....	31.5	50.5	67	72.5	71	106
Watts observed around I and K..	163	280	400	150	175	20
Calculated watts from DC readings I and K.....	189	349	496	169	244	51
Sum of observed watts around I and around K.....	187	297	405	170	197	35
DC volts R.....	70	53.5	34.5	36.5	32	1.5
AC volts R.....	72	56.5	38	41.5	37	34
Watts observed R..	505	450	295	160	160	10
Watts calculated from DC readings R.....	490	415	267	91	104	.75
DC volts total.....	100.5	100	101	102.5	102	104
AC volts total.....	100.25	100.25	100.5	102.5	102	102.5
Sum of DC volts around I, K and R.	96	99	97.5	105	104	103.5
Sum of AC volts around I, K and R.	176	259	306	286	299	196
Watts observed total.	675	740	655	325	340	35
Watts computed from DC readings total.....	703.5	77.5	782	256	331	52
Sum of observed watts around I, K and R.....	692	747	700	330	357	45
Sum of computed watts around I, K and R.....	672	766	755	262	338	52
Ohms I measured...	4.55	4.55	4.55	5.9	5.9	50
Ohms I computed from DC readings.	3.3	5.5	7.75	26.8	21.7	203
Ohms K measured..	.305	.305	.305	.305	.305	.305
Ohms K computed from DC readings.	.43	.39	.39	.6	.46	1.0
Ohms R measured..	9.8	6.54	4.8	9.8	8.53	2.0
Ohms R computed from DC readings.	.01	6.9	4.45	14.6	9.85	3

watts around each portion of the circuit, using the direct-current instrument readings. This, it will be noted, is a rough check on the sum of the observed watts around each portion of the circuit taken by the indicating wattmeter. In this connection, however, it may be observed that the individual amounts going to make up these two sums differ widely among themselves. Thus we have in Test 1, observed watts $137 + 50 + 505 = 692$ and the calculated watts are $161 + 21 + 490 = 672$.

The indications of the alternating voltmeter add up to an enormous figure. They are evidently indications of alternating voltages which must be widely displaced in phase. If we should connect a d'Arsonval instrument in an alternating circuit, there would be practically no deflection because the tendencies to deflect the needle in either direction would be equal and opposite. With an alternating instrument of the dyanmometer type, the alternating pulses of electromotive force or current act in the same direction on the needle. If we should cause to flow through a common return wire an alternating and direct current together and place an alternating and direct-current ammeter in series therewith, the direct-current instrument would indicate only the direct-currrent amperes, while the alternating-current instrument would take some account of both currents. In the case under consideration there was a d'Arsonval and a dynamometer instrument which agreed on pure direct-current circuits, but which exhibited wide discrepancies on circuits on which the wave form was more complex. There seems to be no escape from the conclusion that the discrepancy is due to the presence of an alternating component which passes through zero, the curves above and below the zero line having a substantially equal square not of a mean square value.

The two rows indicating the alternating-current and direct-current voltmeter readings around the rheostat are interesting. The alternating-current readings in each case erceed the direct-current readings. In the case of the last test, the non-inductive resistance had been removed and a highly inductive resistance slightly exceeding two ohms had been put in its place. The discrepancy between alternating current and direct current readings in this case is very large. It is reasonable to surmise, due to the fact that the difference when it exists is invariably in favor of the alternating current deflection, that had the resistance been absolutely non-inductive the indications of the two instruments would have been substantially the same. Similarly, in the case of the observed and calculated watts around the rheostat, while they do not agree, they are not so widely divergent as in the case of the observed andcalculated watts around the coil or interrupter. To this, the last test is an exception, the divergence being quite large, but in the last test the resistance was highly inductive. It is interesting to note that Ohm's law is roughly followed in the case of the direct-current indications. This is true both in the case of the rheostatic resistance and that of the coil itself, which was .3 ahms.

It is interesting to note that the secondary Wehnelt discharge exhibits distinct polarity phenomena. For instance, a single focus Röntgen ray tube operates excellently with the current in the proper direction. The reversal of current reverses the tube, precisely as if an ordinary interrupter were used. This indicates that the secondary current is not of a true alternating character but predominates on one side of the zero line, from which inference can be made that the primary current has a jagged curve showing higher rate of change on the decrease side. The fact that direct-current instruments in the primary circuit give large deflections shows conclusively that the main current value predominates on one side of the zero line, and if it passes through zero at all, remains at that value for a small portion of time.

From what has been said the writer feels that he is justified in making the following conclusions with reference to the Wehnelt interrupter circuit:

1. The current wave predominates on one side of the zero line. It is full of jagged peaks with greater rate of change on the decrease than on the increase. The formidable and unidirectional secondary discharge could not be otherwise accounted for.

2. The voltage of supply can be measured with reasonable accuracy by any suitable commercial instrument.

3. The table seems to show that an indicating wattmeter of the dynamometer type will give approximate results on the various parts of the Wehnelt circuit. A caliorimetric test of the interrupter will greatly assist in verifying this possibility.

4. The inductive portions of the circuit generate a back electromotive force of self-induction, which, combined with the impressed electromotive force, produce a resultant often much larger than the total line voltage and undoubtedly lagging behind the pulsating impressed electromotive force. The electromotive force wave around the inductive resistance is filled with peaks of instantaneous maxima exceedingly steep and abrupt and nearly evenly divided on either side of the zero line.

5. Around the interrupter is generated an electromotive force which combines with the impressed electromotive force, producing a resultant often very much larger than the line potential, and leading the impressed pulsating electromotive force. It is impossible to conceive of two varying electromotive forces inseries, each much larger than the difference of potential at the terminals of the circuit unless they are displaced in phase, one behind and the other leading the impressed electromotive force. We have every reason to believe that the electromotive force generated around the inductive portion of the circuit lags behind the impressed electromotive force. To fulfil our conception, the alternating electromotive force around the interrupter must lead the impressed electromotive force and there-

fore the interrupter acts like a condenser. Moreover, the electromotive force curve around the interrupter is further displaced from the centre with reference to the zero line than a similar curve taken around the reactance because the discrepancies betwen the alternating-current and direct-current voltmeters are not so great.

6. Direct-current instruments may possibly be relied on to measure the total voltage of theWehnelt circuit and the current flowing therein. They take no heed whatever of any alternating resultants due to self-induction or capacity or similar effect, but approximately follow Ohm's law throughout the circuit.

7. The alternating-current dynamometer voltmeter does take account of the alternating resultants around various portions of the circuit and gives an approvimate idea at least of their square root of the mean square value.

The writer hopes through the aid of further experiments in which he is now engaged to be able to evolve more definite information on this subject. At the present writing the wattmerte indications seem to be the best evidence of the division of energy, and from what they show it behooves us if we desire a more equitable division of energy to make induction coils for electrolytic interrupters with primaries of high inductance, exactly the opposite of what is desirable in the case of mechanical interrupters.

Recent Italian Electrical Developments.

BY GIOVANNI GIORGI.

IN Florence a committee has been appointed by the Italian Government in order to investigate the amount of water power from the river Serchio for future utilization in electric traction by the following lines: Viareggio to Bagni di Lucca; Pisa to Sarzana; Livorno to Lucca and Pistoia. The first two lines are now owned and operated by the Mediterranean Company and the third one by the Adriatic Company. The report of this committee will be submitted to the Permanent Central Committee in Rome for approval.

The Società delle Strade Ferrate del Mediterraneo has decided the adoption of electric traction on the lines of Milano-Gallarate, Arona-Laverno and Varese-Porto-Ceresio. The primary current will be high pressure, three-phase, and will be generated by water power. Several secondary stations will convert it into direct current at 600 volts, and feed the line by the third-rail system. The rolling stock will consist of 20 double-bogie motor cars, driven each by a single-reduction motor of 640 brake horse-power. They will reach on a level the speed of 53 miles per hour, attached on a train of seven cars. It is reported that the same company has signed with the Thomson-Houston Company an agreement for the electrical equipment of the line Rome-Frascati.

A royal decree has been entered, approving an agreement signed between the Province of Naples and the municipalities of Castellammare di Stabia, Vico Equense, Meta, Piano di Sorrento, Sant Agnello and Sorrento, for the construction and operation of an electric street railway from Castellammare di Stabia to Sorrento. This line will be about 12 miles long and single track. It will be operated by direct current at 600 volts.

An electric railway line is projected from Fossano to Bra; the project contemplates also the adoption of electric traction on the line Fossano-Mondovi. Electric power will be transmitted to Fossano from Cherasco, where 2400 horse-power will be available.

Electric lines are projected from Savigliano to Bra and from Vezzuolo to Moretta, to be constructed by the "Società per lo Sviluppo delle Imprese Elettriche in Italia."

The tunnel of Giovi between Genoa and Turin of the Società delle Ferrovie Mediterranee has several times been the scene of accidents, due to steep gradients and conditions which make it difficult to remove smoke. These facts have induced to work out a scheme for the adoption of electric traction between Mignanego and Ronco. It is reported that the following system has been decided upon: In Sampierdarena will be installed the power station, driven by water power. Three-phase currents will be led at high pressure up to the stations of Mignanego and Ronco, and there transformed into direct current at 700 volts. The electric locomotives for passenger trains will be of 840 horse-power, and those for freight trains of about 544 horse-power each.

Recently schemes have been approved by the Italian government for the construction and operation of an electric railway line between Gastelraimondo and Camerino, and another between Roma and Ostia on the sea-shore. The latter will afford a direct and rapid communication between Rome and the sea.

On March 16 there was organized in Turin the Mount Cenis Hydraulic Water Power Company (Società delle forze idrauliche del Moncenisio), with a capital of 4,000,000 lires, made up of 40,000 shares of 100 lires each. The object of this concern is the utilization of the water power from the Lake of Mount Cenis, for several purposes, such as for electro-chemical processes, the production of calcic carbide and of aluminum, and power distribution to Turin and neighborhood. The board of directors is composed of Ing. Michele Fenoglio, president; Cav. Ferdinando Licia, vice-president; Mr. Ed. de Noyer, Mr. Carlo Parea, Ing. Gualdrec de Boilleau, Ing. Catella, Ing. Roctisberger.

The firm Soldati, of Turin, in the interest of "Societé Générale Belge d'entreprises électriques" has presented a project and application for the concession of a water power on the river Po, near Lombriasco, and transmitting it to Turin for industrial purposes. The expense is estimated at 3,200,000 lires.

"The Società Italiana per lo Sviluppo delle Imprese Elettriche" of Turin has nearly completed the transmission plant to Fossano and neighboring places. From the Tanaro River at Cherasco, a water power of about 2400 horse-power will be utilized. The dam is completed and also the hydraulic works. The generating units will supply three-phase currents at 10,000 volts.

In Milan a company has been organized by Mr. Rob. Mechwart, Mr. Carlo Coltri and Mr. Frederico Schaeffer, under the name of "Mechwart, Coltri & Co." Its object is to represent the firm of Ganz & Co., of Budapest, and it will have the exclusive control for the sale of their products in Italy. The duration of the company is fixed to 15 years.

By public act at Bergamo, Dr. Gerolamo Rosa, of Bergamo; Dr. Nathanael Bruckner, of Nuernberg; Mr. Fritz Fenzel, of Dossan; Mr. Carl Kolp, of Rostock, have organized a joint stock company under the name "Società Bergamasca per Distribuzione di Energia Elettrica," with plants at Clanezzo, Valle Brembana, and headquarters in Bergamo. The capital is 3,750,000 lires, made up of 7500 shares of 500 lires each. The object is to own and operate a water-power transmission from Vale Brembana, for power distribution in the neighboring towns up to Bergamo. The Schuckert Company is largely interested therein. The board of directors is composed of Mr. Nathanael Bruckner, Mr. August Kassler, manager of the Schuckert Company, and Mr. Giovanni Mariotti, of Milan.

A joint stock company has been organized in Milan under the name "Impresa Laurenzana di Applicazioni Elettriche," having for an object the construction and operation of a large electro-chemical plant by a water power in Isola Liri. The board of directors is composed of Messrs. Gadda & Co., Mr. E. Conti, Mr. E. Sacerdoti and Mr. C. Frigerio. The "Compagnie Electrometallurgique" of Paris is also interested therein.

The Bell Telephone Company.

Several matters of recent occurrence have given rise to many rumors in Boston in connection with the Bell Telephone Company's affairs. The departure for Europe of Directors T. Jefferson Coolidge, Jr., and J. Malcolm Forbes is construed by rumormongers to have some connection with the matter, and the presence in Europe of Mr. J. Pierpont Morgan suggests the belief that the departure of the two gentlemen above mentioned is for a conference with Mr. Morgan, who is a large stockholder in the Bell Telephone Company, and is one of the leading spirits in the Western Union Telegraph Company. The recent presence in Boston of Mr. Theodore N. Vail is used to give support to the theory that he is there as a representative of the Western Union Telegraph Company in connection with a movement whereby the Western Union Telegraph Company is to absorb the American Bell Telephone Company. It is pointed out that if the Western Union Telegraph Company could secure control of the American Bell Telephone Company it would not only have a property able to insure a large surplus above its present rate of dividend, but it would secure a system of wires throughout the country which it could use as well for telegraphic purposes besides being used for telephonic communication. It is consequently concluded that Messrs. Coolidge and Forbes for the American Bell Telephone Company's interest and Mr. Morgan for the Western Union may consummate a trade of this character between the two companies.

Commercial Electrical Measurements and Prices—II.

BY WILLIAM D. MARKS.

(Concluded.)

With the question of cost of current production solved, the next is, How shall we sell it? By contract or flat rate? By the lamp-hour? By the horse-power-hour? By the ampere-hour? Or by the watt-hour? There are cases, as of constant motive power, or of series arc lights, for which measurements need be made only occasionally, as the hours of use are fixed, and in these a contract is commercially the best arrangement. The reader, doubtless, has noticed that in what precedes, the writer has used the lamp-hour, although the steady trend of recent practice is to sell light and power by the kilowatt-hour. There is reason for this, which will appear when incandescent lighting is discussed.

Wherever the number of lamps lighted or the length of time they burn is uncertain, a meter is required. This is equally true of motive power. What gives the most reliable result as between company and consumer, watt measurements or ampere measurements? With varying potential and current, as in trolley car motors, wattmeters are required and should give the more correct results; with constant potential and varying current, direct or alternating amperemeters are more certain and correct. This is particularly true in incandescent lighting, for which more than three-quarters of all the meters made are used.

As a preliminary to a comparison of watt with ampere measurements of current for incandescent lighting, it is proper to call attention to the fact that the candle-power of an incandescent lamp does not vary directly proportionally to either the watts or the amperes forced through its carbon filament. No known law is established enabling one to connect together all the factors entering into the operation of an incandescent lamp. In this matter we must turn to experiment as our guide.

The table which follows is based upon many thousand experiments covering years of work, and with its aid we will compare the results of measurements in watts and in amperes as an index of the illumination furnished. The consumer cares only for the resultant light. The station manager desires, as a matter of good business policy, to give precisely the illumination sold. It is essential to the success of the station that the meter shall record, if not the light in candle-power, that factor of the electric current which is most nearly proportional to it on an average.

Let E_n be normal Voltage of lamp,
" P_n " " Candle-power,
" W_n " " Watts per Candle-power.

From the following tabulated experimental results we can establish the following equations. Let V be the variation in volts from the normal E. For any lamp we have approximately:

$$P = P_n \left(1 + \frac{6\ V}{100}\right)$$ For instance, if we assume

$P_n = 16$ and $V = +3$, we have

$$P = 16 \left(1 + \frac{6 \times 3}{100}\right) = 19 \text{ candles approximately.}$$

If we assume $V = -2$ we have

$$P = 16 \left(1 - \frac{6 \times 2}{100}\right) = 14 \text{ candles approximately.}$$

Inspection of the following table shows that the candle-power of incandescent lamps varies directly with the variation in the voltage from the normal, and that roughly we can say, "a volt a candle," within allowable limits of variation in ordinary good practice with 16-cp lamps normal near 100 volts.

We can also say that $V = E - E_n$,

E being the electromotive force actually at the lamp, our equation then becomes:

$$P = P_n \left[1 + \frac{6\,(E - E_n)}{100}\right] = P_n - \frac{6\ P_n\ E_n}{100} + \frac{6}{100}\ P_n\ E$$

$$P = P_n \left(1 - \frac{6\ E_n}{100} + \frac{6}{100}\ E\right) = \frac{6}{100}\ P_n\ A\ R - \text{constant}$$

in which E is the independent variable; P the dependent variable, and the rest are constants. We have thus found a commercially handy relation, showing the candle-power of a lamp, P, to be a function of the voltage at the lamp, E, or since the resistance R is nearly constant, of A (amperes). The vast sums of money invested in incandescent electric lighting render the smallest details of it worthy of careful experimental investigation.

The following table of experimental data and its application to a 100-volt, 16-cp incandescent lamp will form the basis of our investigation of the accuracy of ampere measurement or watt measurement for incandescent electric light:

Experimental Value.			Application to 100-Volt. 16 c. p. lamp.			
Voltage % Normal.	C. P. % Normal.	Watts per Candle.	Candle Power from data.	One lamp. Watts from data.	Comp. of Amps. Carbons Const R.	Comp. of Amps. from obs. Watts.
94	69	3.92	11.04	43.28	0.466	0.460
95	74	3.76	11.84	44.52	.472	.469
96	79	3.6	12.64	45.50	.477	.474
97	84	3.45	13.44	45.68	.481	.478
98	89	3.34	14.24	47.56	.486	.485
99	94	3.22	15.04	48.43	.491	.489
100	100	3.1	16.00	49.6	.496	.496
101	106	2.99	16.96	50.71	.501	.502
102	112	2.9	17.92	51.97	.506	.509
103	118	2.8	18.88	52.86	.511	.513
104	124	2.7	19.84	54.57	.516	.515
105	131	2.62	20.96	54.91	.521	.523
106	138	2.54	22.08	56.08	.526	.529

To further reduce to commercial practice we will take up the meter bills of a consumer using 20 lamps—100-volt, 16-cp—for two hours each day for one year, and from the above tabulated results show how ampere measurement and watt measurement compare with the actual light delivered to him.

The assumption is made that the voltage can be kept constant with an allowed variation of 3 volts either way, and that the average is 100 volts.

This is within limits which should exist in all stations.

At 97 volts a 16 cp lamp 100 nor. gives 13.44 candles.

His just bill. 12264 Sixteen c p l hours at $\frac{744}{1000}$ c. $ 91.24
" Watt " $666\frac{928}{100}$ K.W. hours at 15c. 100.04
" Amp." $6978\frac{8}{10}$ Amp. hours at 1½c. 104.68

At 100 volts a 16 c.p. lamp 100 nor. gives 16 candles.

His just bill. 14600 sixteen c p l hours at $\frac{744}{1000}$ c. $ 108.62
" Watt " $724\frac{160}{1000}$ K.W. hours at 15c. 108.62
" Amp." $7241\frac{6}{10}$ Amp. hours at 1½c. 108.62

At 103 volts a 16 c p lamp 100 nor. gives $18\frac{88}{100}$ candles.

His just bill. 17248 sixteen c p l hours at $\frac{744}{1000}$ $ 128.31
" Watt " $771\frac{756}{1000}$ K.W. hours at 15c. 115.76
" Amp." $7489\frac{8}{10}$ Amp. hours at 1½ 112.35

What the consumer has contracted for and the company agreed to deliver is twenty 16-cp lamp held at that illumination and the just bill for it is $108.62. He cannot honestly be held for anything else or for variations in voltage and light.

The average of the watt measurements is $108.14.

The average of the ampere measurements is $108.55.

The assumption is that the extreme allowable variation either way from normal voltage is 3%, and that the normal voltage is very closely averaged. The error of the watt meter is 48 cents and of the ampere meter 7 cents, assuming both to measure with perfect accuracy.

The average 16-cp lamp hours delivered is 14,702 ($109.38). Where, as in this case, a contract has been made for 14,600 ($108.62), the ampere measurement is more nearly correct than the watt measurements. The average candle-power of the lamps is 16 11-100.

The wise, skilful and honest station manager who will be careful to keep his district voltage within a 3% variation from normal will find that ampere measurements are more correct and more just and profitable to the station than watt measurements for light, and he

will also find that there is no advertisement equal to a satisfied consumer, and that no comforts are greater than small lamp renewals and a full treasury.

Should anyone be so unfortunate as to have wide variations in voltage, ampere measurements do not vary so widely from the contract average of light, and therefore will not create dissatisfaction among consumers by unexpectedly great variations in bills from the estimated contract price.

The theorist unfamiliar with practical station running might at first sight say that watt measurements approximate more closely to just records than ampere measurements, but on second thought he will see that owing to more rapid variations in the watts the average is not so correct, and all stations must be run on averages.

We have in the preceding example:

The contract price	$108.62
Actual lamp hours (14,702)	109.38
Average ampere hours	108.55
" watt "	108.14

Both show an actual loss to the station of light delivered but not metered to the consumer, and it amounts to a great deal of money. The difference between ampere measurement averages and watt measurement averages is 48 cents in $108.55, or 44 2-10 cents saved per $100 gross income. For a gross income of $500,000 this difference amounts to $2210 in a year. There is a further measurement loss in lamp hours of nearly the same amount, but we have as yet no meter capable of registering it.

There also remains, in badly managed stations, the two cases of voltage habitually carried low or high.

In the first case, an enormous injury is done to electric lighting, and no saving in lamp-life can compensate for the loss of business to the electric company which will immediately result. In the second case, voltage is sometimes purposely put up two or three volts while burning out old and blackened lamps and replacing them with new ones of the higher voltage. In this case the lower records of the amperemeter as compared with the wattmeter compensate for the loss of brilliancy in the old lamps and give a more correct result for the new lamps of higher voltage. *Whatever the voltage may be, and whether the current be direct or alternating, amperemeters average more correct results than wattmeters in the measurement of incandescent electric light,* and should for this reason be used for it. The further mathematical reason for this is that (P) the candle-power of a lamp is a function of the voltage (E), minus a constant, and since the resistance of the filament of a lamp (R) is constant within the usual limits of incandescence, (P) the candle-power is also a function of the current (A) passing, and not of (EA) the watts used.

To the station manager this will be obvious. *To use a wattmeter in a well regulated incandescent station is to lose a great deal of honestly earned money for your company*; maybe a good portion of your own salary, which, it is expected, you will save many times over because of your special skill in science and conscientious vigilance in making and saving money as manager.

The conclusions reached up to this point are:

The length of time of use of the electric current is the most important factor in fixing its price.

Watts should be the basis of measurement of power with varying potential.

Amperes should be the basis of measurement of incandescent light with approximately constant potential.

We come next to the meters—there are hundreds of them; some based on watts, some on amperes, but of these meters less than a dozen types have been practically used on a large scale. The Edison chemical amperemeter, while giving correct results, has been prohibited by law in many countries and is constantly suspected by consumers, and for that reason seems after many years of good service to be going out of use, being replaced by various mechanical meters. On direct constant potential currents it has not been found inferior to the Thomson mechanical wattmeter. Speaking of loss in unrecorded current, the expert of the largest Edison company in the west says, after an experience with thousands of meters: "With our chemical meters this loss was averaging about 18 per cent., and now with one-half of our output measured by wattmeters it is but 2 per cent. better, so that it would still amount to 14 per cent. if wattmeters should be adopted entirely. This is undoubtedly due to the fact that after being in use for some time the meters become much slower on light loads than on one-half load." *(This means 14 per cent. of the gross station income.)*.

"It is not the intention of this paper to at all decry the wattmeter; yet it is true that it has not come fully up to our expectations as an improvement over the old chemical meter. In point of expense its first cost is more, and its operating expense fully as large. In point of accuracy it has so far proved little better, though it seems to have possibilities of better results *with frequent and careful inspection.*"

"In point of general acceptability to customers, however, the meter is far in advance of the chemical meter."

The essence of this able expert's paper is that friction in the recording train of gears and at the commutator brushes and on the supporting jewel all combine to slow the meter, and that in a little time this friction grows so that it is greater than the power of the motor for one or two lamps, and this, too, after showing marvelously accurate results during a short preliminary test in the laboratory.

Placing himself on the consumer's side, he further says:

"The liability of the meter to become fast owing to the demagnetization of the drag magnets by a short circuit must be carefully looked after or the customer may have just cause for complaint."

In one case a 450 ampere 110-volt meter was found 47 per cent. fast owing to a heavy short circuit on the line, and frequently meters are found from 20 to 30 per cent. fast from this cause.

As to the large number of defective jewels which were found, it seems impossible to get a jewel that will not crack or wear under the weight of a meter disc and armature."

These words from an absoluely impartial expert are quoted in preference to giving the writer's own opinion, which some might think biased by his own labors in the field of electric measurement.

We can now state the conditions which a commercial meter must fulfil before the mechanical meter can be perfected.

(1) It must be a strong machine capable of withstanding ordinary shocks of handling.

(2) It must work well when a little out of order, not requiring exquisite adjustment to do its work.

(3) Its record must not be affected by friction.

(4) Its record must not be affected by varying permanent magnets used as a brake or drag.

(5) It should show the passing load all the time.

(6) It should record its load in a straight row of figures not on dials.

(7) It should be able to record a commercially light load of about 1 per cent. of its rated capacity unless this falls below say ¼ ampere or 25 watts. It is not commercially worth while to go below these small amounts.

(8) Its motive current should cost very little.

(9) It should not require lubrication or be made incorrect by a little dirt or dust, requiring only ordinary care and cleanliness.

(10) It should withstand short circuits without derangement of its calibration.

(11) It should be calibrated ready for erection and not require a subsequent recalibration after erection.

(12) *Once right it should always be right; i. e.,* the principles upon which a mechanical meter is designed must be such that there is no reason, if the maker's work is done properly, why the meter should not always register correctly until worn out.

One of the difficulties with all wattmeters results from the feeble force with which two solenoids without iron cores tend to place themselves in the same plane with coincident axes, and their weak control of attachments to them. Theoretically, at least, wattmeters should be used for power measurement with varying potentials and inductive loads. With the existing wattmeters and the feeble forces moving them, the influence of variation of friction in recording trains, commutator brushes and jewels frequently causes heavy losses, and again the variation of strength of the drag magnets causes the meter to wildly run away. The 14 per cent. loss which the meter expert of the Chicago Edison Company regretfully deplored was probably 14 per cent. of a million—$140,000—lost that year, about 7 per cent. dividend on $2,000,000 of their investment. It is worth looking after and getting. There are Klondikes outside of Alaska!

Aside from the fact that amperes measure incandescent illumination more correctly under commercial conditions than watts, an amperemeter has a very strong control of its measuring needle, which can be made just as strong and certain as desired, and the lag entirely eliminated by carrying a shunt circuit around a soft iron needle, so as to supersaturate it with electromagnetism. This the writer has done and experimentally proved. For this practical reason, if no other, direct and alternating constant potential circuits should have amperemeters attached for all non-inductive loads, and perhaps for

some inductive loads, with a power factor. If the recording train is driven by means of an armature or disc, any variation in the friction of the meter will show itself in the speed of rotation of this disc or armature and the meter be in error. At light loads the friction seems to be most vicious in its effects.

A clock train controlled by a pendulum or balance wheel seems to be the only mechanism whose record of time is independent of variations in friction, and for this reason the only method of making electric meters independent of variations in friction in their records. This pendulum or balance wheel movement the writer has utilized in his work, making it electrically-driven and self-starting.

The final meter upon which all will agree will be made under the 12 conditions placed, and will drive out all others in which the principles involved are incorrect, or which having makeshifts in them carry with them an apology and warning to look out for them to the purchaser and user.

The realization in a practical form of the perfect pendulum meter is a matter of patience and ingenuity and rich should be the reward to its creator. It is not an impossible task, and present forms of motor meters on the market will vanish before it, as the Edison chemical meter is now doing before them.

CURRENT NEWS AND NOTES.

THE OHIO INDEPENDENT TELEPHONE COMPANIES' ASSOCIATION will hold its annual meeting in Cleveland on May 9 and 10. It is stated that in the neighborhood of 150 independent companies will be represented.

THE INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES will hold its next annual meeting in Cleveland on June 12, 13 and 14. Judge J. W. Thomas, of Chillicothe, Ohio, is president of the association.

MUNICIPAL TELEPHONE SYSTEM IN SAN FRANCISCO.—The Public Utilities Committee of the San Francisco Board of Supervisors, at a recent meeting, decided to recommend the advisability of issuing an immediate call for a complete municipal telephone system. The call, which has been drawn up, will require bidders to provide a system with a capacity of from 18,000 to 25,000 subscribers.

MR. CARL HERING has been appointed by the United States Government an official delegate to the Paris International Electrical Congress. The Franklin Institute has also appointed Mr. Hering to represent it at the several technical congresses to be held in connection with the Paris Exposition. As announced some time ago, Mr. Hering has also been named one of the United States members of the jury of award for the electrical group.

AN EGYPTIAN LIGHTING PLANT.—Cairo, Egypt, has a central station supplying no less than 35,000 lights of 10 candle-power. Sulzer engines are direct-connected to Brown-Boveri alternating-current generators of 2000 volts and 40 p. p. s. Concentric cables are used for distribution. There are 90 transformer stations at which the current is stepped down from 2000 to 100 volts. The headquarters of the company, known as the Compagnie Generale du Gaz, is at Paris. Its capitalization is 26,000,000 francs.

PROF. CLARENCE L. CORY, Professor of Electrical Engineering in the University of California at Berkeley, has been excused from all general University duties for the next academic year in order that he may devote a large portion of his time to consulting engineering, in which he will be associated with Messrs. A. M. Hunt and Wynn Meredith. Prof. Cory will retain his present position in the University, directing the work in electrical engineering and superintending the operation of the electric light and power system of the University.

COPPER FROM TAILINGS.—A plant is about to be established at Hancock, Mich., to test a process for saving copper in tailings from Lake stamp mills. Careful assays showed tailings carried from .2 to .8 of 1 per cent. from active mines. It is claimed that practically all this copper can be recovered. It is reported that contracts have been made with many lea ing mines for the exclusive right to remill tailings by the process. The value of copper now lost in tailings by Lake copper mines reaches several million dollars annually.

ELECTRICAL COMMUNICATING PROPERTIES.—According to a statement recently made by President C. J. Glidden, of the Erie telephone system, the total investment in electrical communicating properties in the United States aggregates $275,000,000. The investment in telephone properties, he says, is about the same as that in telegraph properties. The latter is divided as follows: Western Union Telegraph Company, $125,000,000; the Postal Telegraph Company, exclusive of cables, $13,000,000; total, $138,000,000. Total telephone investment, $137,000,000.

VOLTAGE AND CURRENT RECORDER.—Mr. F. W. Springer, of the electrical department of the University of Minnesota, has devised an apparatus for automatically recording current and voltage. It is a combination of chronograph and Weston direct-current instrument, and gave excellent results in a recent test on a 40-hp laboratory motor. The instrument records between 50 and 100 readings per second. A strip of paper 10 ins. wide and 90 ft. long is used an hour. The apparatus was constructed for use on street cars to determine the power required in accelerating under different conditions of track, loads, motors, speeds, etc. The advantage of such a device is apparent when one attempts to take all the variations in current and pressure while a car is being rapidly started.

EXCLUSIVE FRANCHISES.—The Supreme Court of West Virginia handed down an important decision recently in the case of the Clarksburg Electric Light Company vs. the City of Clarksburg, holding that a municipal corporation cannot grant a franchise for exclusive privileges. It appears that the electric light company had obtained an injunction restraining another company which had been chartered for the purpose of furnishing light in a hotel, opera house and bank building, and to certain private parties, from carrying out its intention, alleging that in 1887 it had obtained an exclusive franchise to furnish light, water and other improvements. The injunction was later dissolved by a lower court, whereupon an appeal was taken to the Supreme Court. The decision of the latter is stated to establish a new precedent.

THE ST. ANTHONY FALLS POWER.—Some years ago there was a movement on foot whereby a general electric plant was to be built at the falls of St. Anthony, at Minneapolis, Minn., for the purpose of supplying electricity to all the flouring mills. This plan fell through, but the Pillsbury Company has acquired the Holly mill water power and will at once begin the construction of a direct-current plant of 250 kilowatts to light its own group of mills on the west side and the "A" mill on the east side of the river. The latter is about 2500 feet from the proposed site. The three-wire system will be used. It is interesting to note that the present plant has been in operation for about twenty years, and was the first one installed in Minneapolis. The Weston incandescent and the Brush arc systems were used. Later, the Edison three-wire was put in

NEW YORK STREET RAILWAY FEES AND PERCENTAGES.—Preparations are being made to bring action against the surface and elevated railways of New York City for unpaid car license fees, percentages of receipts and for repavements. The sum due on account of fees and percentages is about $700,000, and that due for repavement about $500,000. The bills on which the corporation counsel intends to bring suit have been in dispute for nearly ten years and every street railway in this city will be a defendant in one or more actions. The Third Avenue Railway was organized as a stage line, and for years it paid a license for each "coach" which it ran. Since the motive power of the line was changed to cable and electricity, it is said, the company has refused to pay any car license fees, on the ground that its cars are not coaches.

MINNESOTA UNIVERSITY NEW SHOPS.—The College of Engineering of the University of Minnesota is to have new shops, and the plans are now being prepared under the direction of Professor Flather, of the mechanical department. The shops will cover a ground area of 47 by 235 ft., with an addition on one side of foundry of 20 by 50 ft. The pattern shop will be located directly over the

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machine shop, but the forge room and foundry will be only one story in height. The building will be of brick and heavy timber—the slow-burning mill construction being used throughout. The floors consist of 2 by 4s laid on edge, side by side, on 6 ft. centres, and these are covered by 1-inch maple laid diagonally. The building will be wired for electric lights, and electric motors will be used for driving. The group system will be used with 220-volt direct current motors.

GAS ENGINES FOR WARSHIPS.—Some experiments are to be made to demonstrate the feasibility and advantage of propelling a ship through power derived from gas engines supplied by gas generated on the vessel itself. The coal, instead of being consumed under the boilers to make steam, will be roasted in retorts aboard the ship to extract the gas for the engines. The coke thus produced, it is estimated, would furnish all the fuel needed to roast the coal. The purpose of the experiment is to ascertain whether the saving of weight of the gas-producing plant and gas-consuming engines over the ordinary plant of steam boilers and engines, and the saving of space, are sufficient to warrant the adoption of the new system.

LEAKAGE CURRENT INDICATION.—In a patent issued April 24 to Martin Kullmann, of Berlin, Germany, a method is described for indicating and measuring leakage of current from electrical conductors. At the two points between which it is desired to determine if there is leakage, are placed in circuit two known resistances. If now these resistances are equal and the ends of the first are connected to one side of a differential galvanometer, and the ends of the second to the other side of the galvanometer, there will be no deflection if the current flowing through both resistances has the same value. In carrying out the method practically, a millivoltmeter is employed with a double bridge, one bridge connecting with the extreme ends of the distant resistances, and the other with the adjacent ends. The patent describes the application of the method to house installations on both the two and three-wire systems, to the electric return circuit and to long-distance conductors.

NATIONAL ELECTRIC LIGHT CONVENTION.—Unusual interest is being manifested by central station managers throughout the country in the meeting to be held at Chicago May 22, 23 and 24. The indications are that there will be a very large attendance of electric lighting men. The programme has been made up in accordance with suggestions from central station managers as to their needs, and a glance will show that the themes treated are in the hands of men that thoroughly understand their subjects. Among the papers to be read are the following: "Uniform Accounting," by Lieutenant James Blake Cahoon, Syracuse, N. Y. "Equitable, Uniform and Competitive Rates," by Henry L. Doherty, St. Paul, Minn. "Central Station Economies," by W. L. Abbott, Chicago, Ill. "Series Inclosed Alternating Arc Lamps," by William Lispenard Robb, Hartford, Conn. Other papers and topics of equal interest will be announced later. The committee reports are also of value, and promise to be very complete.

BURSTING OF A FLYWHEEL.—In November, 1895, the flywheel in an Albany power house burst and a piece of the wheel killed a man in a neighboring saloon, which led to a suit for damages just terminated by a decision of the court of final appeal. Two engines were running machines in parallel when the engineer noticed a violent sparking at the commutator on one generator, and opened its circuit in the belief that the automatic governor of the engine would prevent it from running dangerously fast until he should have time to reach the throttle, which was distant only 24 feet. He then immediately shut off steam from this engine, and, while passing to the second engine, the flywheel of the first burst from centrifugal force. The court held that even upon the assumption that the engineer made a mistake in breaking the circuit before he cut off steam, it was not sufficient proof of negligence to charge the company with responsibility for the accident, it appearing that the engineer acted promptly and used his best judgment.

AN ENGLISH STREET RAILWAY ASSOCIATION.—The rapidity with which tramway and light railway enterprises are being promoted and carried through in England has drawn the attention of many of those interested to the necessity of an association similar in some respects to the American Street Railway Association of the United States. An association has been formed under the name of the Tramways and Light Railways Association, with offices at Amberley House, Norfolk Street, London, W. C., and Mr. A. M. Willcox has been appointed honorary secretary. As all tramway and light railway enterprises, whether promoted by corporations or companies, are initiated and under the control of the same legislative act they have, of necessity, many relations in common, and such an association will be useful in expressing the common views and requirements. The first inaugural banquet of this association was held on Wednesday, April 25, in the Voctoria Hall, Hotel Cecil, London, and many subjects of common interest were discussed.

MAXIMUM-DEMAND SYSTEM.—In a patent granted April 24 to H. O. Westondart, a maximum-demand meter of simple construction is described, of which a number of forms are shown, all based upon the same principle. One of these consists of two bulbs each of which has a horizontal stem united to a common vertical stem, and along the side of the latter are arranged vertically a large number of small pockets. The lower bulb is partly filled with liquid—as, for example, colored water—and has also within it a small coil connected with the supply circuit. The upper chamber contains air or other gas. The arrangement is such that as the gas in the upper part of the lower chamber is expanded by the heating effect of the current in the coil, the liquid is caused to rise in the vertical tube and to successively fill the pockets up to the highest level which the column takes. When the current decreases, the liquid will recede, but a certain amount will be left in the aforesaid pockets. It will thus be possible to determine from an inspection of these pockets how far the liquid has risen, and consequently fix the value of the maximum current flowing during a given period.

FERRO-CHROMIUM.—Ores rich in chromium are rare and dear, and when treated by ordinary processes for the manufacture of ferro-chromium, a product rich in chromium and free from carbon is difficult to obtain. In a patent granted April 24 to Emile Vielhomme, of Froges, France, a method is described for producing ferro-chromium in the electric furnace. Chromite is treated in the electric furnace with a flux suited to the conditions—kaolin, lime, fluorspar, etc. The action of the electric current is continued after complete reduction and fusion until total or partial volatilization of the iron. The boiling-point of chromium being higher, the product becomes richer in chromium as it becomes poorer in iron. The part played by the flux is not only to produce a fusible slag, but by its presence in the crucible it furnishes a medium moderately resisting the passage of the current, which allows of easy regulation and secures high temperature; also, by its partial volatilization there is a drawing off of the iron vapors. Chromites containing oxides of chromium, magnesium, calcium, aluminum and silicon in various proportions according to its quality has added to it coke or other carbon. With the furnace employed by the inventor it is stated that 22 lbs. of lime, sand, kaolin and fluorspar are employed for 100 lbs. of chromite treated.

SYSTEM OF ELECTRIC TRAIN CONTROL.—The electric control of trains whereby all of the motors of the train are simultaneously regulated to obtain the desired torque and speed and to be stopped and started together, has been carried out in a number of different ways. One method provides ordinary direct-current motors, commonly called pilot motors, for rotating controlling devices; in this case, each car has a controlling device for its own motors, and the arrangement of the circuits from the master controller is such that the different motors which are geared to the controller are rotated to the same extent and practically simultaneously. Another system dispenses with the rotating motor and substitutes separately controlled contacts, which may be operated by any convenient source of power, such as compressed air or electric current, applied by magnets or a similar device. A patent issued April 24 to Harold W. Buck describes a system belonging to the first class mentioned. Instead, however, of using the ordinary direct-current motor for rotating the different motor controllers, a device is employed which is rotated by means of two-phase currents, which currents are derived from the ordinary direct-current supply of intermediate mechanism, which is operated as the master controller. The master controller consists, briefly, of a pair of rheostats so connected across the mains that as one of them is cut out the other is cut in, which gives rise to two currents differing in phase. The apparatus at the various controllers consists of a Gramme ring to which these two-phase currents are supplied, whereby a rotary field is set up in the ring and a magnet mounted in the ring is thereby caused to take up a position corresponding to the position of the handle of the master controller.

ELECTRIC HAULAGE ON CANALS.—The Delaware and Raritan Canal in New Jersey has received the first electric motor which will be used for towing boats along this waterway. The motor is in the form of an automobile, and will travel along the towpath. It is stated that these machines will haul from three to five boats in tow at the rate of five miles an hour. Under the old system of mule power, the speed was only two miles an hour, so that in addition to the probable saving in expense, it will also effect a great saving of time.

LETTERS TO THE EDITORS.

A. I. E. E. Nominations.

To the Editors of Electrical World and Engineer:

Sirs:—In giving consent to a telegraphic request for the use of my name in connection with the "Dr. Pupin for President" circular, I feel that it is but just to say that while I favored Dr. Pupin as an independent nominee, I would have withheld my consent had all the circumstances of the case been known to me.

LYNN, MASS. ELIHU THOMSON.

A Question of Terminology.

To the Editors of Electrical World and Engineer:

Sirs:—Has the term "Invested Rotary" come to stay? Certainly it is a misnomer. Literally speaking, an invested rotary is one that has been turned up-side-down, and the term has no reference whatever to the kind of current the apparatus receives. There is no more reason for calling a rotary converter which receives direct current energy and transforms the same into alternating current energy an "inverted rotary," than there would be for styling a step-up transformer an "inverted transformer."

Some one may say: "The objection seems reasonable, but what other term is suitable?" There is no need of another term. It is just as easy to write "Alternating currents are obtained from the direct current bus-bars through the medium of a rotary," as to say they are obtained through the medium of an "inverted rotary." The meaning is fully expressed and there is less chance for confusion. The fact that a rotary, operating from its direct current end, has characteristics that are not present when it is operating as a synchronous converter, is entirely irrelevant. The present tendency is to relieve technical literature of ill-chosen terms. Let us not add another.

BUDD FRANKENFIELD.

MADISON, WIS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous Converters.—MEYER.—An illustrated article on the use of synchronous converters and their different types. There are three types: (1) Converters with shunt excitation, (2) with compound excitation, requiring a sufficient reactance in the circuit for the regulation of the voltage, which is shown in diagrams; (3) without field coils, and in which, as the excitation is obtained by the armature current alone, the current lags at any load, and the efficiency is small. If converters are used for converting continuous into three-phase current, they should always be run with overexcited field, and safety apparatus should be used, consisting of centrifugal interrupters which disconnect the direct current as soon as the speed has attained a certain value; or the converter may be excited separately and the exciter may be mounted on the same shaft as the converter, so that if the field of the converter is weakened and its speed increases, the exciter voltage is increased and the field strengthened. The synchronous converter has not yet been introduced to any exent in Europe.—*Elek. Zeit.*, Apr. 5

Unipolar Dynamo or Motor.—ASHER.—A suggestion of an improvement in the Faraday machine with a view to diminishing greatly the losses due to the friction of the brushes. Usually the current is led off from brushes on the outside of the disc; the present writer suggests passing the yoke of the flat circular field magnet through an opening in the centre of the armature disc and revolving the magnet; this enables the armature to remain stationary and permits leading the current off from the outside edge by fixed wires, which replace the usual objectionable sliding contacts; from the inside edge of the armature the currents are led off with brushes, but there the surface speed is not nearly as great. Small machines of this kind might be used as motors in connection with batteries or thermocouples of low voltage but great current capacity; he suggests their application for automobiles and launches.—*West. Elec.*, Apr. 14.

REFERENCES.

Compounding of Non-Synchronous Converters.—WESSELY.—An illustrated paper read before the Electrotechnical Society of Vienna, on the method of Hutin and Leblanc.—*Zeit. fuer Elek.*, Mar. 11.

Weight Economy of Dynamos.—ROSENBERG.—The first part of the complete paper, an abstract of which was noticed in the Digest, April 7.—*Zeit. fuer Elek.*, Apr. 1.

Double-Current Generator.—BROCKSMITH.—An illustrated article giving the design of a 2-kw six-pole machine.—*Am. Elec.*, April.

Fan Motors.—A very long, well-illustrated description of a large number of 1900 models of fan motors.—*Am. Elec.*, April.

LIGHTS AND LIGHTING.

Three Arcs in Series.—An illustrated description of a device of Koerting and Mathiessen for switching on three arcs connected in series. When the lever of the switch is brought to the first notch the current goes through a resistance and two arc lamps, which are thus lighted under favorable conditions. By switching to the second notch, this series resistance is disconnected and replaced by the third lamp.—*Zeit. fuer Beleucht.*, Feb. 20.

Cost of Lighting.—A note giving a table of Lemmers-Danforth for the approximate cost of 16 candle-hours with different methods of lighting: 0.05 to 0.125 cent for electric arc light; 0.1 cent for petroleum incandescent light; 0.188 cent for Welsbach incandescent light, 40 candle-power being assumed as average during its life and including renewal of mantle; 0.4 to 0.6 cent for acetylene; 0.5 to 0.75 cent for electric incandescent light, the cost of energy being assumed at 10 to 15 cents per kw-hour, without taking into account the diminution in candle-power; 0.7 cent for the ordinary flat-flame gas burner. It is claimed by the General Electric Co., of Berlin, that on a large scale passenger cars can be lighted electrically at a cost of 0.45 per 8 candle-power; so far, however, this figure does not appear to have been reached in practice.—Lond. *Elec. Rev.*, Apr. 13.

REFERENCES.

Theatre Lighting.—A very brief description of the electric lighting installation of the Covent Garden Theatre, of London.—*La Nature*, Mar. 31.

Arc Lamp.—MERSCH.—An illustrated description of an arc lamp, the chief feature of which consists in a special method of providing the solenoids with an iron sheathing, which regulates the distance between the carbons.—*Zeit. fuer Beleucht.*, Feb. 28; *Elek. Rund.*, Mar. 15.

Incandescent Lamp Filaments.—A description of Ganz's patented method for the preparation of electric incandescent bodies of magnesia or alkaline earths, with a conducting core of metal.—*Zeit. fuer Beleucht.*, Mar. 10.

POWER.

Tonawanda Power Co.—A long, very well illustrated description of the station at Tonawanda, 10 miles from Buffalo and 14 miles from Niagara Falls, where the transmission line, from the falls to Buffalo is tapped and the alternating current is converted into continuous current for supplying the street and interurban railway in the

neighborhood, and alternating current is also supplied to motor-generators for arc and incandescent lighting. The station is of a somewhat new type in high-tension work, being a way station tapped onto a transmission line and the junction point of a branch transmission line to Lockport. The arrangement of the circuits is interesting on this account and also because the plant contains the first equipment of the Westinghouse apparatus for reverse-current and time-element current breaker protection. This is described and illustrated, also the transformers, synchronous converters and motor-generators.—*Am. Elec.*, April.

Electric Power Distribution in an Agricultural District.—A note on a power plant under construction near Aachen, Germany, for supplying an extended area, the radius of which is about 3 miles, with electric light and power; also current to a 16-mile interurban railway, which connects 21 towns. The current for the latter purpose is generated by two continuous current dynamos, each of 210 kilowatts; for the light and power distribution three alternators of together 900 kilowatts generate three-phase current of 6000 volts, which is transmitted by bare wires to the towns of the area and transformed there down to 120 volts. Transportable motors will be rented.—*Elek. Anz.*, Apr. 1.

Power Transmission.—A brief article on an electric transmission plant now under construction in France. The water-power plant in Allassue will develop 4000 horse-power, of which 1000 horse-power will be transported to Limoges, over 45 miles, the balance to different other cities. On the transmission line to Limoges a tension of 20,000 volts will be used, which will be transformed down to 3000 volts in a sub-station near Limoges. This is said to be the highest voltage used in Europe.—*L'Energie Elec.*, Feb. 1.

Lausanne.—DE MORSIER.—An article on the electric installation of Lausanne, Switzerland. The water-power of the River Rhone is utilized. For transmission from St. Maurice to Lausanne, Thury's continuous-current series system is used, and for distribution in Lausanne three-phase, alternating current at 3000 volts underground, giving after transformation 3 x 125 volts. With this network all small motors are connected; a separate network of the same voltage and the same system supplies those motors which, when running, would disturb the electric lighting.—*Revue de l'Elec.*, Jan. 15, Feb. 28.

Power Transmission.—GOLDSBOROUGH.—An article on the limitations of long-distance power transmission. The insulation and leakage difficulties, and the influence of the charging current, are briefly discussed. He concludes that when coal is scarce and power is in demand, power can be generated and delivered at distances of upward of 500 miles from the generating station, and a liberal return derived in interest upon invested capital.—*Elec. Rev.*, Apr. 18.

Improved Efficiency of Engines.—Some editorial notes on the device of Behrend and Zimmermann (Digest Jan. 6). It is said to be of interest as a purely laboratory demonstration of a scientific truth, but it is highly improbable that steam engine practice will be affected in the least by the experiment.—*Am. Elec.*, April.

REFERENCES.

Controller.—An illustrated description of a multiple solenoid system of controlling printing-press motors, used by the Cutter-Hammer Mfg. Co.—*Am. Elec.*, April.

Electricity in Mines.—PERKINS.—An illustrated description of electric coal-cutting machines, a self-propelling truck, shearing machines and of the methods of operation and means used in fastening the machines in place where the space at hand is limited.—*El'ty*, Apr. 25.

Polyphase Power Plant.—PERKINS.—An illustrated description of the power plant of the Montana Power Co., at Butte, Mont.—*Elec. Rev.*, April 18.

TRACTION.

Palermo.—A well-illustrated article on the tramway system of Palermo, Sicily. The trolley system is used with a voltage of 500. Between Rocca and Moureale on a line of about 0.9-mile length, there is a continuous grade of 7 per cent to 12 per cent; there are two tracks; on these lines each car is coupled to a locomotive; whenever a car with locomotive is running down, another car with the other locomotive is running up. Both locomotives are connected together by a metallic cable running on loose rollers, and at the upper end around a drum. The locomotives weigh 7.5 tons, and are provided with a single 60-kw shunt motor. During the whole cycle the descending locomotive furnished the whole driving power in order to keep the cable taut; if necessary it may be aided by the motors of its car. The combined lighting and traction house contains a battery of 196 Tudor cells, with a capacity of 3500 ampere-hours at normal discharge and three steam-driven dynamos, one with a single armature giving 1060 amperes at 300 volts to 350 volts; the other two dynamos have a double armature, each armature giving 530 amperes at 300 volts to 350 volts; the two armatures of a dynamo may be connected in series or in parallel. so as to give 530 amperes at 700 volts, or 1060 amperes at 350 volts; the first connection is made for traction, the second for lighting. For lighting, the three-wire system is used with 150 volts at the lamps.—*L'Energie Elec.*, Mar. 1.

Single-Rail Lines.—Some editorial notes on the single-rail electric railways between Liverpool and Manchester, and between Barmen and Elberfeld (Digest Sept. 16, Dec. 23, and *West. Elec.*, Apr. 21); in the former the Lartigue system is used, the car straddling the rail and riding upon it; in the latter, the Langen system, the car being suspended vertically beneath the rail, the truck which carries the motor and driving wheels being attached to the roof of the car. The latter system appears to impart greater stability to the car when in motion, especially for high-speed working, but seems to be considerably more expensive. Electric traction facilitates the construction and working of single-rail tramways; the small weight of each moving unit, and the high speeds and accelerations which the introduction of the electric motor has rendered possible, must bring into prominence the advantages of this type of line, wherever rapid transit and cheap construction are desired.—Lond. *Elec.*, Apr. 13.

Electric Automobile.—RIKER.—A New York Elec. Soc. paper, describing in a general way the variation of speed by series parallel control, of parts of the battery, a combined volt and ampere-meter for use on the automobile, a device which makes a wrong connection for recharging impossible, and the methods used to make one wheel of the carriage travel faster than the other, when turning around a corner. For an automobile which has been in almost constant use since 1897 and has covered over 20,000 miles during this period, the cost for battery maintenance has been $150, or three-quarter cent per mile; the current, as supplied with the regular Edison Co.'s rate of 10 cents per hp-hour adds 1¾ cents per mile, making the total cost 2½ cents. —*El'ty*, Apr. 18.

Electric Locomotives.—A long illustrated description of two electric locomotives, one for shunting purposes and the other for use in a mine. The first is driven by two motors running at a speed of 275 r. p. m., each giving 23 horse-power at 500 volts; the gear wheels are in the ratio of 1:3.5. The mine locomotive had to be made exceptionally heavy to get the necessary adhesion, on account of limitations in size and the small gauge; it has two motors, running at 525 r. p. m. and giving each 45 horse-power at 500 volts; the speed is reduced in the proportion of 10 to 1.—*Zeit. des Ver. deut. Ing.;* briefly abstracted in Lond. *Elec. Rev.*, Apr. 13.

REFERENCES.

Chicago Subway.—An illustrated article on the subway system proposed for the business section of Chicago.—*West Elec.*, Apr. 21.

Rail Bonding.—A brief illustrated communication on the application of Goldschmidt's method of the production of high temperatures (Digest Sept. 2) for welding the rails of street railways. The method is said to have proved satisfactory in practice in Essen.—*Elek. Anz.*, Apr. 8.

Gasoline Automobile.—FIELD.—A New York Elec. Soc. paper on the development of gasoline vehicles here and abroad.—*El'ty*, Apr. 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electrical Equipment of Warships.—GROVE.—A continuation of his illustrated paper (Digest Apr. 28). The incandescent lamps are usually arranged in six circuits for different departments, while in the U. S. Navy the lamps are arranged on two main circuits, the battle and the lighting circuit. Lead-covered cables and wires are universally used, the insulation is vulcanized india-rubber in all cases; he says that none of the methods adopted in foreign navies appear to be as safe or as thorough as the British Admiralty method of lead-covered cables closely packed together, visible and accessible throughout their length. A simple, compact and effective method is described, to be used where the wires go through watertight bulkheads or decks. The larger main circuit cables from the switchboard pass through "junction boxes," into which they split usually into two branches protected by fuses; each of these branches then passes through a series of section boxes, which are circular watertight boxes containing a switch and four pairs of terminals for the attachment of fuses and the branching of cables. Each of the four pairs of cables running from a section box terminates in a distributing box, which is similar

to the section box and contains fuses and a double-pole switch. From each distributing box eight pairs of wires are taken, each pair leading direct to the terminals of one lamp. A typical British Admiralty watertight fitting, showing the method of wiring is illustrated and described. The international navigation lights and the position lanterns are briefly described. On some ships, tell-tale alarms are used to give warning, if one of the navigating lights fails; such an arrangement is described and illustrated. For searchlights the Parsons mirror is standard in the British Navy; it is a thin parabolic mirror of high quality. The discussion which followed the paper is abstracted in a separated article in the first of the two journals.—Lond. *Elec. Rev.*, and *Elec. Eng.*, Apr. 13.

Polyphase versus Continuous-Current System.—An abstract of an inquiry held in Dublin in connection with the projected extensions of the electric lighting and motor system. Hammond proposed three-phase generation and transmission from a new power station to be erected at Pigeon House Fort, outside the city, the present single-phase system to be fed from substations; S. P. Thompson and de Ferranti were in favor of this scheme. Tomlinson said the two-phase system of distribution would have gotten over certain anomalies, and would fit in better with the existing system. Wright and Parshall were in favor of a continuous-current system. Regarding the proposal of the tramway company to furnish the current to the city from its power house at a low price, Parshall, the company's electrical expert, said that if he were the company he would not be bothered with a business that would be less profitable. An editorial in the Lond. *Elec.* agrees with this opinion; while it will generally be advantageous to an ordinary electric supply undertaking to include electric tramway supply, it is not generally other than a distinct disadvantage for an electric tramway undertaking to take on the business of electric lighting and public supply. The question whether the polyphase or continuous current system is the more likely to survive, is left open in the editorial; the chances of both systems are said to turn upon very evenly balanced advantages and disadvantages.—The abstracts of the proceedings on the inquiry in Lond. *Elec.*, Mar. 30, Apr. 6; the editorial in Lond. *Elec.*, Apr. 13.

High Voltage Safety Device.—An illustrated description of a device of Partridge to prevent the dangers arising in a system of high voltage, alternating-current distribution mains, when by the connection or removal of a section of the circuit at the switchboard a momentary rise in the pressure on the mains of 50 per cent, or even more, is caused, so that there is danger of breaking down the transformers and other part of the plant which is across the mains. The inner conductor of a concentric cable is connected to an insulated knob, which makes with another knob an adjustable spark gap; the path of the spark after leaping the gap leads to one of a pair of metallic horns, the width between which increases with increasing height. The gap between these two horns is normally short-circuited by one arm of a metallic lever, the other arm carrying an iron core suspended at the opening of a solenoid. The passage of any considerable discharge across the gap energizes the solenoid and attracts the iron core, thus lifting the tip of the other lever arm from the one horn until it strikes the other horn; the torrent or flash between the first horn and the tip of the lever is thus transferred to the two horns at a point where the gap is sufficiently wide to allow the convection currents to lift the flash bodily upward, until it is extinguished by the widening between the upper part of the horns. The apparatus is said to be remarkably prompt in operation.—Lond. *Elec.*, Apr. 13.

REFERENCES.

Pressure Regulators for Lighting Installations.—Stadelmann.—A long, mathematical article, illustrated by diagrams, giving methods for calculating the resistances of regulators to keep the pressure in lighting circuits constant at varying loads.—*Elek. Zeit.*, Apr. 12.

Storage Batteries in Theatres.—An unsigned article stating that while the storage battery is part of the electrical equipment of most first-class theatres, it has not been so used greatly in America. Its extreme usefulness for that purpose is shown with respect to the widely fluctuating load in a theatre.—*Am. Elec.*, April.

Fault Signals.—Probst.—A well-illustrated article on the use of automatic fault signals in concentric high tension alternating current networks.—*Zeit. fuer Elek.*, Apr. 1.

Wires, Wiring and Conduits.

Resistance of Copper Wires.—A note on some tests made to determine the order of the increase in the resistance of copper wire during its manufacture into cable. The copper wire had originally a conductivity of 101 to 102 per cent of Mathiessen's standard and the completed 91 strand cable had a conductivity of but 93 per cent. The handling of copper wire tends to increase its specific resistance, independently of the stretching that takes place during stranding; possibly the resistance which was measured may also have been increased by the fact that the individual wires are longer than the finished cable owing to the spiral course of each strand.—Lond. *Eng.*; editorially commented upon in Lond. *Elec.*, Apr. 13.

REFERENCES.

Cable Breakdowns.—Kapp.—The first part of a French translation of the German article abstracted in the Digest, Jan. 20.—*L'Elec.*, Mar. 31, Apr. 7, 14.

Electro-Physics and Magnetism.

Coherer.—Haerden.—An illustrated account of careful experiments in which he observed the actions of a coherer having only one contact point, with a microscope. This contact point was formed by two very small spheres at the end of two platinum wires or by two perfectly ground steel points. He observed that under the influence of electric waves, sparks go over from one point to the other, transporting small quantities of matter so that a conducting bridge is formed, which, however, is destroyed by percussion.—*Elek. Zeit.*, Apr. 5.

Lichtenberg Figures.—Buerker.—An article describing a new mixture of powders which gives results far superior to the usual sulphur and red lead combination. He pulverizes five volumes of flowers of sulphur with one volume of solid carmine as used in histology, and adds three volumes of lycopodium seed. When this powder is dusted on to a brass plate coated with asphalt, the positively charged parts appear a beautiful dark red, the negative parts bright yellow, both regions being sharply marked off from each other. The positive figure shows, besides the main red circle, a yellow centre and a yellow outer halo, while the negative figures show distinctly a red centre and a red outer halo.—*Ann der Physik.*, No. 3; abstracted in Lond. *Elec.*, Apr. 13.

REFERENCES.

Electromagnetism.—Raveau.—A French Physical Society paper, in the first part of which he gives a brief summary of the researches of different authors regarding the fundamental law of electromagnetic action. In the second part he deals with unipolar induction. The paper is highly theoretical.—*L'Eclairage Elec.*, Mar 10; more briefly in *L'Ind. Elec.*, Mar. 25, and *L'Elec.*, Mar. 31.

Vacuum Light.—Volk and Vesely.—An illustrated description of an apparatus for lighting with vacuum tubes. It consists of a cylindrical Geissler tube, with a cross-section of ring form, in the interior of which there is an inductorium with interrupter.—*Zeit. fuer Beleucht.*, Feb. 20.

Electro Chemistry and Batteries.

Electrolytic Production of Alkalies and Chlorine.—Kershaw.—An illustrated article on the use of mercury cells for that purpose. The advantage of using mercury as cathode material is due to the fact that mercury forms an alloy, or amalgam, with sodium or potassium at ordinary temperatures, and thus removes the liberated metal from the chemical action of the solution. The most successful mercury cell is the Castner cell (Digest, Apr. 22, 1899); the Rhodin cell is another application of the same principle; in both the mercury lies on the bottom of the cell, the amalgam forms upon the upper surface of the mercury and being the lighter, floats upon it is a crust; this crust is to be removed mechanically at short intervals of time. He describes two new cells in which this removal occurs automatically by the force of gravitation. In the first, devised by Crudo and Bisazza, the lower surface of the mercury is the active part of the cathode, and as the amalgam forms it rises through the supernatant mercury; in the simplest form of the cell a glass or porcelain vessel provided with a porous bottom contains the mercury, and above it water or a weak solution of sodium hydrate; electrical contact with the mercury is made by means of a spiral of iron wire. This vessel is suspended in a second vessel, containing a solution of common salt, and an annular anode of sheet platinum. On closing the circuit sodium is liberated at the lower surface of the mercury and forms at once an amalgam, which, being lighter than the supernatant metal, rises through it and floats upon its surface; here it comes into contact with the water and lumps of ferrous sulphide, and is rapidly decomposed into its original mercury and a solution of sodium hydrate with evolution of hydrogen gas. Two other forms of

the same cell for operation on a large scale are illustrated; also a fourth one devised for the purpose of preventing the defect that the chlorine passing from the anode compartment of the cell contains hydrogen. A disadvantage of the cell is the diaphragm between the anodic and cathodic departments, as it is kept in a high state of efficiency only with difficulty and as it increases the internal resistance. The second cell is invented by Kynaston. The mercury is supplied continuously to the cell by supply pipes at the upper end and flows in zig-zag fashion over the narrow shelves which line the sides, until it arrives at the bottom of the cell and is carried off by a pipe. The successive shelves are supplied with transverse ridges and run-off pipes at alternate ends. Each shelf is thus kept constantly covered with a layer of mercury ⅛ inch deep, and only the lighter amalgam passes off from it to the one next below it. The feeding of the mercury and the strength of current passing through the cell, is regulated so that the mercury passing out by the exit pipe contains the maximum percentage of sodium possible for the temperature at which the cell is worked; it is decomposed in a separate vessel and the mercury is then returned to the cell. In the middle of the cell is the carbon anode and above it the exit pipe for chlorine gas. Lond. *Elec. Rev.*, Apr. 13.

Action of Carbon upon Refractory Oxides at High Temperatures.—BEADLE.—A theoretical article in which he first discusses the modern methods of producing high temperatures. Two reactions can take place when an oxide and carbon are heated together; first the reduction to the metallic state, second the production of the carbide of the metal; it depends upon the proportion of the carbon to oxide introduced into the furnace, as to which of these takes place. In a table he gives the amount of carbon theoretically required to produce these reactions and the nature of the carbide when formed. It is not absolutely necessary that the oxide should be introduced as such, but the metallic salts, which are capable of calcination to an oxide or a mixture of oxides, may be used; thus sulphates, carbonates, or other more complex salts may be mixed directly with carbon; in a table he gives the various metals which can be produced in this way. A third table gives briefly some of the most useful properties of the carbides which are not generally known. Only two of these have come into commercial use: calcium carbide on account of its property of evolving acetylene when decomposed by water, and silicon carbide or carborundum on account of its excessive hardness. It appears that both these carbides might be replaced by others; thus boron carbide would replace carborundum; barium carbide, strontium carbide or lanthanum carbide, might replace calcium carbide, but for the high price of their respective bases. When decomposed with water, manganese carbide evolves a mixture of methane and hydrogen; the carbides of the cerium group evolve methane and acetylene; thorium and uranium carbides yield, in addition, some hydrogen.—Lond. *Elec. Rev.*, Apr. 13.

REFERENCE.

Thickened Electrolyte for Dry Cells.—A note stating that if a certain secret compound called "salammoniac calcidum" is used (already referred to several times in the Digest) a thickened mass may be obtained by the solution of ordinary glue. Such solutions are said to last very long.—*Elek. Anz.*, Apr. 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Three-Phase Current Wattmeter.—An illustrated description of a device of Siemens & Halske, by which a phase difference of 90° is obtained between the magnetic fields produced by the series and shunt coils. The shunt coils are arranged with three non-inductive resistances in the form of a Wheatstone bridge, so that the two shunt coils are opposite sides of the bridge; the bridge thus formed is connected in series with an induction coil and shunted across the mains. An exact phase difference of 90° between the two fields is obtained by adjusting the non-inductive resistance which is the diagonal bridging part of the Wheatstone bridge; by increasing or diminishing it, a phase difference below or above 90°, respectively, is obtained.—*Elek. Rund.*, Apr. 1.

Hot Wire Shunt Instruments.—WAGNER.—A brief illustrated article on the use of hot wire shunt instruments as alternating ammeters. It is claimed that the indications are not to be depended upon when the instrument has been calibrated by a direct current; they are much more accurate, if the calibration is made with an alternating current. A very convenient method of calibrating is to have a small current transformer arranged to slip over the cable and connected in series with the ammeter shunt, and so wound that an ammeter of 15 or 25-amp. alternating current can be conveniently used; if the latter is properly shielded the calibration is very reliable.—*Am. Elec.*, April.

Differential Testing With Single Coil Instruments.—HANCHETT.—An article illustrated by diagrams, describing how to arrange an ordinary voltmeter or ammeter, to measure the difference between two pressures or two currents. The simplest case is that of two independent e. m. fs. which can be connected in any way desired; they may be connected in opposition and a voltmeter placed between the two free terminals. If two machines are connected in series, as two railway motors or two dynamos on the three-wire system, the free terminals of both machines may be connected with two exactly equal resistances in series and the common junction of the two machines may be connected to the junction of the two resistances through a voltmeter, then the difference in the two e. m. fs. is equal to double the reading of the voltmeter. For measuring e. m. fs. on the three-wire system the resistances may be identical lamps. He describes methods of measuring the difference between currents in any two circuits in parallel by a single reading of an ammeter, also a wattmeter connection enabling a single instrument to record the difference in power given to two electrical devices operating from the same source.—*Am. Elec.*, April.

Meter.—BERGMANN.—An illustrated description of a meter, in which each of the fixed current coils attracts or repels simultaneously two pairs of pressure coils mounted on double levers and oscillating with a short amplitude, like horizontal pendulums. The difference thus produced in the motion of two wheelworks measures the energy consumed.—*Zeit. fuer Beleucht.*, Feb. 28.

REFERENCES.

Measuring Instruments in High Tension Plants.—Two communications by Widmann and Schueler, continuing the discussion on the merits of their methods (Digest, Jan. 6, Mar. 31, Apr. 14).—*Elek. Zeit.*, Apr. 12.

Meters.—An illustrated abstract of a paper read before the Electrotechnical Society of Vienna, describing several types of meters for different rates of charging. The discussion which followed is abstracted.—*Zeit. fuer Elek.*, Mar. 25.

TELEGRAPHY TELEPHONY AND SIGNALS.

Differential Telemichrophonic Relay.—MERCADIER.—An illustrated description of an instrument to be used in his system of multiplex telegraphy with the transmitting tuning forks and the receiving "mono-telephones." It collects at either end "all the signals made on a base line of sinusoidal currents" of periods varying from 480 to 900 per second. These currents constitute 12 notes differenig from each other by a semi-tone, and extending from si-three to la-four. The apparatus consists of a telephone, whose diaphragm is 10-cm in diameter; around the arms of the electromagnet two identical wires are wound. To the telephone is attached a microphone consisting of a small plate of carbon screwed to the middle of the diaphragm, and another carbon attached to a metallic mass fixed to a flat spring insulated from the frame by an ebonite plate. One of the wires of the electromagnet is connected with the line circuit, the other with an artificial circuit, in order to eliminate the effects of transmission upon the receivers at the sending station, like in the "differential" method of continuous-current duplex telegraphy. The microphone is inserted into the circuit of a cell and primary of an induction coil, and the secondary of the latter is connected to the 12 receivers which correspond to the 12 transmitters. Each receiver picks out its own note with perfect accuracy without responding to the neighboring ones. No disturbance or confusion is produced by the six transformations of energy involved. Signals have been successfully sent between Paris, Toulouse and Bordeaux.—*Comptes Rendus*, Mar. 19; *L'Ind. Elec.*, Apr. 10; *L'Eclair. Elec.*, Apr. 7; *L'Elec.*, Apr. 14; abstracted with an illustration of the instrument in Lond. *Elec.*, Apr. 13.

REFERENCE.

One-Minute Telephone Rates.—TROWBRIDGE.—A brief article on the successful schedule of the Michigan Tel. Co. of time rates based on minute conversations, the rate being one-fifth of the old standard five-minute rates, with a minimum charge of 15 cents for minute service. The average conversation can be kept within one minute and a half. It is expected within a year to have minute rates throughout Michigan, Wisconsin, North Dakota, South Dakota.—*Am. Elec.*, April.

MISCELLANEOUS.

Electric Treatment of Tuberculosis.—An illustrated article on a method devised by Crotte and used in the St. Luke's Hospital in New York. He uses formaldehyde gas, which kills the germs of tuberculosis, and introduces it into the diseased lung tissue "by the use of

static electricity, sponge electrodes being saturated with the medicine in solution." His static machine is illustrated; the voltage is said to be considerably over 1,000,000, and the amperage very low.—*West. Elec.*, Apr. 21.

Magnetism as a Growth Stimulator.—A brief account of experiments, made by Dr. Herdman (University of Michigan) with guinea pigs placed at certain times in a solenoid about three feet in diameter, through which an alternating current of 5 amperes is passed, so that the animals were subjected to an alternating magnetic field. He found that "alternating magnetic stress is in some way related to a quickened metabolism of tissue." Growth can be accelerated in such way, but it must be admitted that it is unhealthy and in the end is disadvantageous to man or animal. Such diseases, however, as rheumatism and gout will in time be treated succesfully by similar methods, by enclosing the patient for a short period each day in an electromagnetic field.—*Elty*, Apr. 18.

REFERENCE.

Electrotechnics.—Hochenegg.—His inaugural address in taking the chair of electrical engineering in the Technical High School of Vienna, giving an outline of the development and present conditions of electrical engineering.—*Zeit. fuer Elek.*, Mar. 11.

New Books.

The Electric Automobile. Its Construction, Care and Operation. By C. E. Woods, E.E., M.E. Chicago and New York: Herbert S. Stone & Co. 177 pages, 22 illustrations. Price, $1.25.

This latest addition to automobile literature is in no sense a technical or engineering work, but, as the author states in his preface, was written "to set forth in plain and unembellished English the facts and conditions surrounding the question in hand so that those interested in the subject might learn the elementary conditions and thereby purchase an electric automobile with some discrimination, and give it intelligent care and skillful operation."

As an elementary handbook of information for those considering the purchase of an electric automobile, the book may prove of some value by calling attention to points of operation and care which should be followed out in practice, if the best results are to be obtained in the operation of electric vehicles.

The prevailing idea held by the prospective purchasers of automobiles seems to be that an automobile needs no more attention or care than is necessary to give while it is actually in motion. The sooner this notion is dispelled the sooner will the automobile become a success both for pleasure and commercial purposes. Hence any book which calls the attention of the prospective purchaser to the fact that an automobile cannot be operated on the "you press the button, we do the rest" style, even though it does so in the most cursory manner, has in some measure justified its existence.

The treatment of the principles of operation of the storage battery and electric motor in this book has been attempted in non-technical language and can hardly be said to have been accomplished satisfactorily.

The chapters devoted to "Testing and Inspection" and to "Street Operation" will probably be of more assistance to the owner of a newly-acquired electric automobile than the rest of the book. The first named chapter calls attention to many of the troubles that may arise in the operation of electric vehicles, while the second points out a few cautions which it is well to observe while operating in the street. The remainder of the book is devoted to the constitution and by-laws of the Automobile Club of America and to the racing rules drawn up by the Automobile Club of France. The book is illustrated with many cuts and photographs of the Woods electric automobile, and an appendix is devoted to a description of these vehicles and their accessories. Though the author has attempted to treat the subject from an impartial point of view, only his own make of electric vehicles has been used as an example, the limiting effect of which is apparent in many places.

Directory of Electrical Societies, Etc.

Brooklyn Institute of Arts and Sciences, Department of Electricity. Annual meeting May 4.

Chicago Electrical Association. Next meeting, May 4. Paper "Road Test on Street Railway Motors," by Prof. P. B. Woodworth.

National Electric Light Association. Next meeting, Chicago, May 22, 23 and 24, 1900.

Independent Telephone Association of the United States. Next meeting, Cleveland, Ohio, June 12, 13 and 14, 1900.

Continental Arc Lamp.

A new departure is claimed for the type of enclosed arc lamp shown in the accompanying illustrations, in that it employs an arc of 100 volts instead of one of 80 volts as heretofore used in such lamps, thus giving a saving of energy corresponding to this difference of voltage. The arc is claimed to be double the length of the 80-volt arc, thereby giving greater light, while it has the advantage of requiring less dead resistance on commercial circuits, corresponding to that required to take up the difference of 20 volts; the figures given are 40 per cent gain in light per watt at the lamp or 12 per cent. gain in light per watt at the arc.

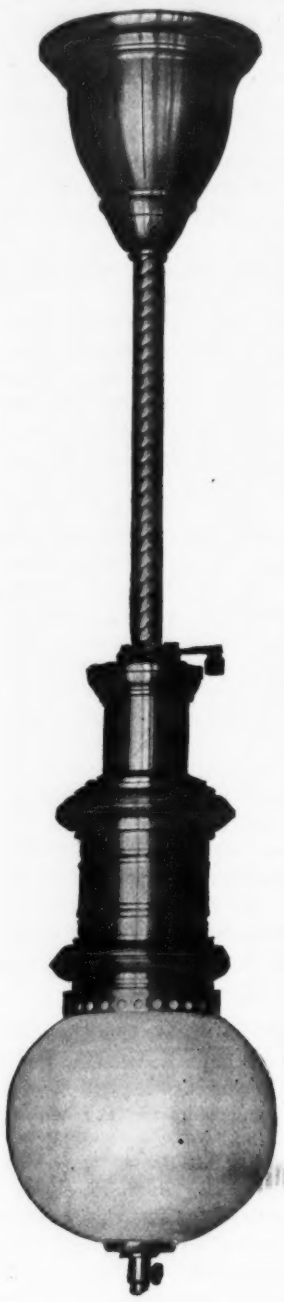


FIG. 1.

FIG. 2.

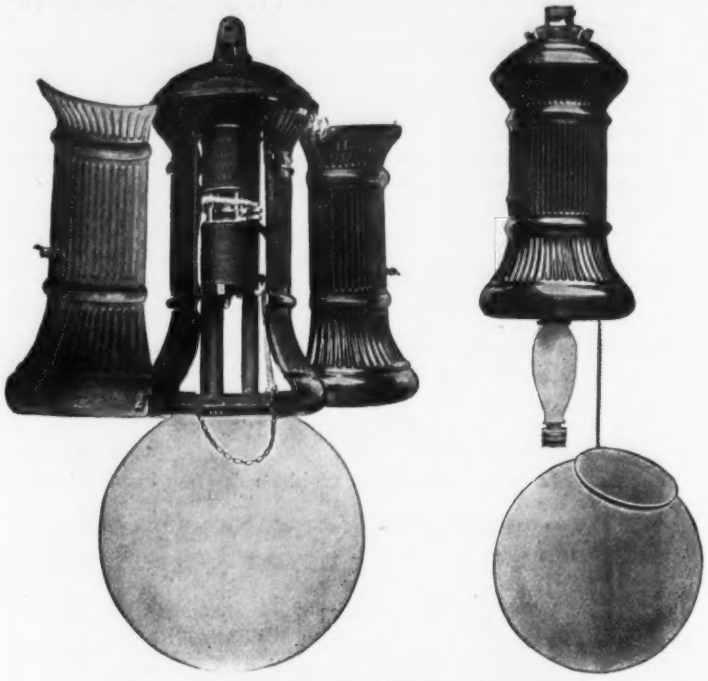
The method of regulation is stated to consist in operating the lamp-magnet mechanism by a current which fluctuates ahead in time of wave fluctuations of current, which may take place at the arc, whereby the arc is lengthened or shortened in time to check all fluctuations of current at the arc without the use of dead resistance. The means employed to effect this comprises an inductance coil, as shown at the top of Fig. 2, connected in parallel with the lamp-magnet windings, this arrangement causing wave fluctuations of current to "lag" in the inductance coil and consequently "lead" in the lamp-magnet windings. Fig. 1 shows the standard style of lamp, the inductance coil being within the canopy. The maker of the lamp, known as the "Continental Enclosed Arc Lamp," is the Continental Electric Company, Boston, Mass.

Belden-Larwill Lamp Case.

A neat form of case for arc lamps has been brought out by the Belden-Larwill Electric & Manufacturing Company, of Fort Wayne, Ind., and is illustrated herewith. The case is stamped out of steel, brass or copper, as desired. It is made in four vertical sections, two of them being in the form of doors, which are set opposite each other, thus allowing free access to all parts of the mechanism of the lamp.

The doors open from top to bottom the entire length of the case, and when open do not interfere with the outer part of the globe.

The design of this case is said to be original with the company, and is not a particularly recent idea with it. The style of case hitherto used on the lamps of this company were adopted for the time being until completed dies for the new case could be gotten out. The photographs of the first case have just been received from the

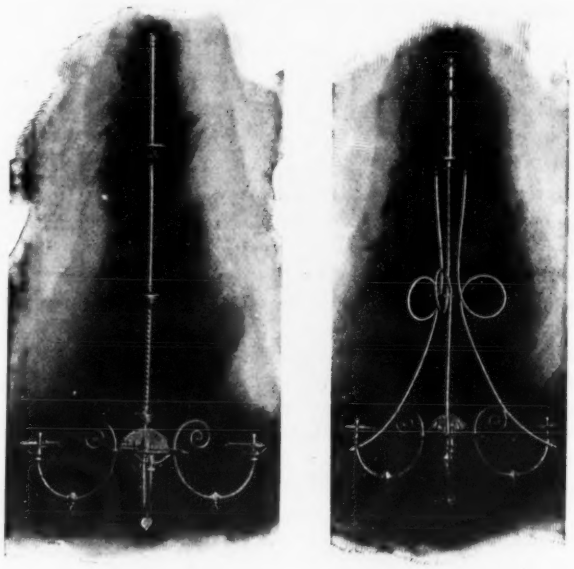


FIGS. 1 AND 2.—BELDEN-LARWILL LAMP CASE.

manufacturers, and these form the subject of the illustrations. This case, it will be seen, is at once both artistic in construction and of practical utility.

Coverette.

One of the specialties of the Pacific Electric Company, La Crosse, Wis., is a flexible tube, known as "Coverette," and used principally as a conduit for electric wires. It is particularly adapted to shop work where there are drop lights. The enclosure of the wires by



FIGS. 1 AND 2.—COVERETTE.

this means gives a handsome and rigid appearance, keeps the lamp from swaying and protects the wires from contact with nails or substances which cause short circuit. A further application is shown in the illustrations. One cut shows an ordinary chandelier while the other shows a combination gas and electric fixture using the old chandelier by adding to it "Coverette" in decorative forms. The fact that the tubing is flexible adds greatly to its usefulness, as it may be bent in any shape, and some pretty forms are easily made. Coverette has been passed upon favorably by the Board of Electrical Inspectors in Chicago, and quite a demand is reported for this product, which combines the useful with the artistic and introduces at the same time an element of safety.

Mietz Kerosene Engine.

The liquid fuel engine using common kerosene lamp oil is becoming a very popular motor where gas is not available. The cheapness of this engine as compared with the cost of the ordinary steam engine and boiler, its self-contained independence of operation and the low cost and ease of handling the fuel employed, constitute effective

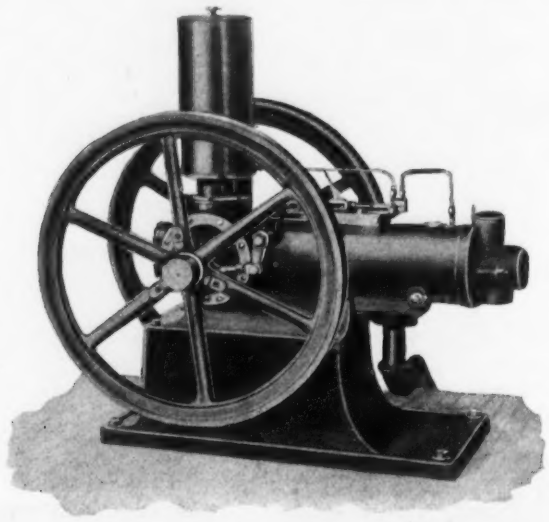


FIG. 1.—KEROSENE ENGINE.

recommendations, and it is not strange to find it so rapidly gaining in favor for small units of power. A large number of these engines have gone into successful operation, and they have been found especially satisfactory in employment for isolated electric lighting plants.

In Fig. 1 is shown a kerosene engine of the two-cycle type. An explosion occurring and an impulse being nominally imparted for each revolution, the claim is made that this type is more susceptible

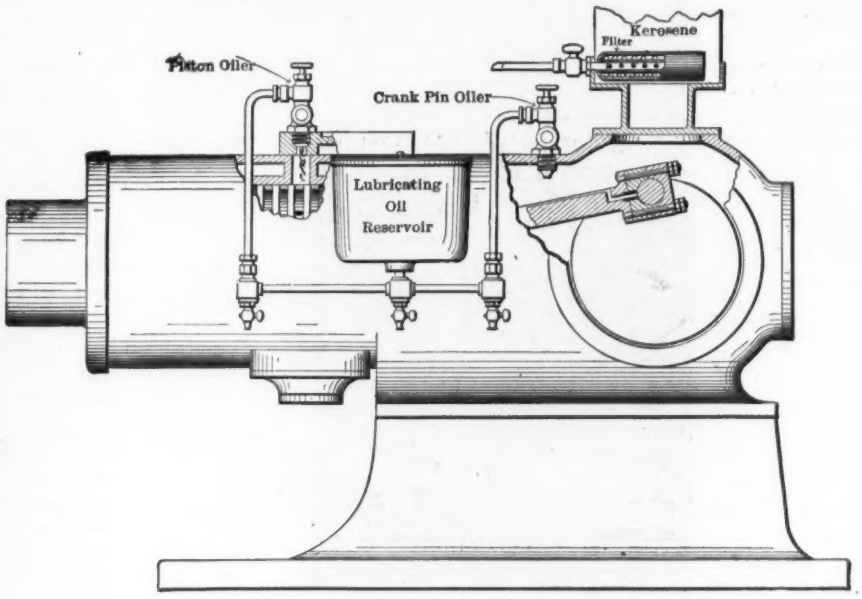


FIG. 2.—LUBRICATION OF CRANK PIN AND PISTON.

of easy and close speed regulation than the four-cycle engine, while the governing device employed is highly effective.

The parts of an oil engine requiring lubrication are comparatively few, but it is of utmost importance for those to be properly attended to. Ring oilers in this case are used for the main bearings, as shown in Fig. 3, and the lubrication of the crank pin and the piston is taken care of as shown in Fig. 2. An oil reservoir is placed at the side of

the engine frame, and at a certain portion of each revolution there is a partial vacuum in the crank chamber and also in the cylinder, which is sufficient to draw the necessary oil up the copper pipes and down past the sight holes, which permit its regulation by the sight feeds above. The oil for the crank drops into a groove on the top of the rod, whence it finds its way along to the pin.

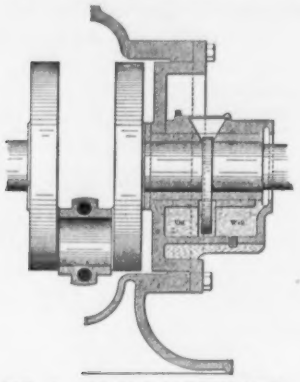


FIG. 3.—CRANK LUBRICATION.

These automatic oiling devices, it will be noted are only operative when the engine is running; when the engine is stopped they require no looking after. One peculiarity of this, as of other oil engines, is that it has no throttle valve. When the engine is to be stopped it is only necessary to throw up the little finger which operates and regulates the admittance of oil. The manufacturer of this type of engines is A. Mietz, 128 Mott Street, New York.

Garton Lightning Arresters.

We illustrate herewith some new models of lightning arresters put out this year by the Garton-Daniels Company, of Keokuk, Iowa. Fig. 1 shows a new direct-current pole arrester for railway, light and power circuits of 750 volts or less, with iron cover. Both the base

FIG. I.—DIRECT-CURRENT POLE ARRESTER.

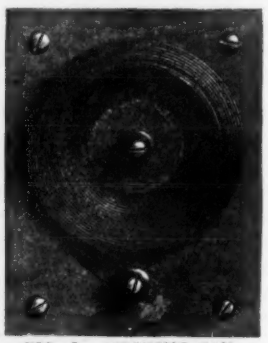


FIG. 2.—KICKING COIL.

and spool are made of porcelain, and the general design is such that the manufacturers feel confident that its operation will be perfectly satisfactory under all conditions.

A novel construction is employed in the iron box, it being made

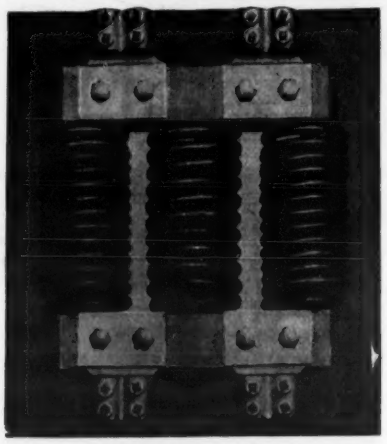


FIG. 3.—1200-AMPERE KICKING COIL.

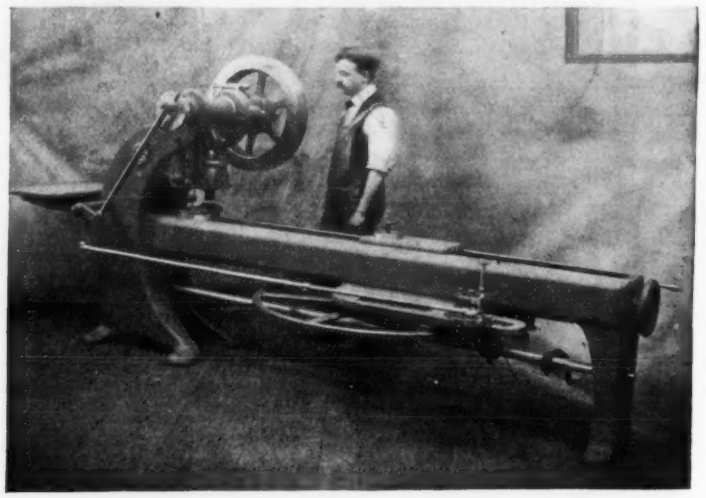
so that the loosening of one screw at the bottom of the box allows the lid to slide upward, and swung to one side, thus permitting the inspection of the arrester with the greatest ease. This same type is also provided with a wooden cover of tongue and groove construction at exposed joints, and provided with a sliding lid, with spring catch to allow easy inspection. The iron cover is 6 ins. wide, 10¾ ins. high and 5 ins. deep, and with the arrester weighs eleven pounds. The wooden cover is 6⅝ ins. wide, 12½ ins. high and 6 ins. deep, and with the arrester weighs five pounds.

In designing new models the Garton-Daniels Company has adhered to the same general lines which have made its devices so successful in the past, and retain the feature of opening the circuit in two places after the discharge has passed to earth—thus allowing the use of a much smaller air-gap than would be practical were the circuit opened in one place only.

Another new type of arrester is for the protection of stationary motors of all sizes, and Fig. 2 shows a new type of "kicking coil" for use with it. The devices are particularly adaptable for the protection of fan and other small power motors. Fig. 3 shows one of a 1200-ampere "kicking coil," of which a number have been furnished to Messrs. Siemens Bros. & Co., Ltd., of Woolwich and London.

Disk-Notching Press.

The accompanying illustration shows a new armature disk-notching press recently gotten out by the Ferracute Machine Company, of Bridgeton, N. J., which has a number of advantages not before embodied in such machines. Among them is a system of change-ratchets and pinions, which, by permutation, allow a large number and variety of notches to be cut. These also avoid on the one hand evils due



ARMATURE DISK NOTCHING PRESS.

to a large and expensive dial for each number it is desired to cut, and, on the other hand, the inaccuracies of indexing due to the numerous gears in a train, when the errors are augmented by the addition of those in each tooth and each journal of the various wheels through which the motion must be passed.

The change-ratchets are so designed that they consist of a simple steel ring, usually 6 ins. but sometimes 12 ins. in diameter, with the required number of teeth accurately cut in the edge thereof. This ring can be changed for other rings in a few seconds, being held by a clamp with mutilated thread, after the manner of a cannon breech-block. Being of this simple form, a number of these ratchets can be cheaply provided which will, when used by picking up any desired number of teeth and using a proper ratio of the large gear to a certain one of these different pinions, produce many hundreds or thousands of different notch numbers. The machine is provided, when nothing is said to the contrary with a 30 pinion and a 45 ratchet which will combine to give 24, 30, 36, 40, 45, 60, 72, 90, 120, 180 or 360 notches. Other ratchets and pinions can be provided instead of the regular ones for about the same price, or additional ones can be supplied at small cost.

Among other convenient features of this machine are an automatic stop for stopping the shaft after one revolution of the disk; also a screw feed provided with hand-wheel and crank for accurately adjusting the carriage on the bed, thus regulating to a nicety the depth of the notch; also elevating the die chuck to keep the die at the right level, regardless of any inaccuracies in its original height and of subsequent wear or grinding down. A ram provided with a slot and set-screws holds punches of simple shape made from a plain bar of steel.

Other features are a newly-designed clamping stripper made from commercial sheet rubber; a 3-in. adjustment up and down for ram; a chute for delivering scrap outside the machine; a convenient and accurate method of fastening centre-plates securely on the disk spindle by means of one bolt, etc.

In addition to the utmost practicable simplicity and lightness in the parts which carry the quickly reciprocating motion as the levers, pitmans, etc., considerable study has been given to accuracy in the parts which particularly need it, especially the disk spindle and the ratchet spindle, these both being mounted with double cone bearings of unusually large diameter and length, which are adjustable to a nicety to take up the wear. The gears and pinions are especially cut to insure accurate division of teeth, and the whole machine is built in the usual style of the best power presses. The ram, bed, etc., are so contrived that they may be used for ordinary punching, outside of disk-notching when the same is required. The "throat" is made so deep that disks may be cut from square sheets, if desired, at the same time they are notched. The ratchet pitmans for the sake of lightness are made of bicycle tubing.

The weight of the press shown is 2700 lbs. This machine has a capacity for notching disks from 2 ft. to 10 ft. in diameter. But by changing the large index gear for a smaller one, work down to 2 ins. in diameter may be notched. Two other sizes of this machine are made, the smallest working disks up to 4 ft. in diameter, and the medium size up to 7 ft.

Ericsson Telephone.

The accompanying illustration shows one of the latest telephone outfits put upon the market. It is a combination instrument which can be used for either wall or desk. The magneto is without gravity hook, and is suitable for both long or short distance work. When used on a desk the magneto is placed in the usual position under the desk, and the combined transmitter and receiver (hand micro-telephone) may be laid anywhere on the desk, in a pigeon-hole, or hung at the side, if more than one person is to use the instrument. Used as a wall telephone, the hand micro-telephone can be hung on an ordinary hook and placed at any convenient height. This instrument, which is handled by the Ericsson Telephone Company, 296 Broadway, New York, is growing in popularity on account of its utility and convenience, it being a most practical instrument for general purposes.

The company's new talking circuit is also reported to be receiving a good deal of attention. It consists of a genuine Ericsson transmitter mounted on an adjustable arm with cord concealed, and an induction coil in the base, a genuine Ericsson receiver and receiver

COMBINATION TELEPHONE.

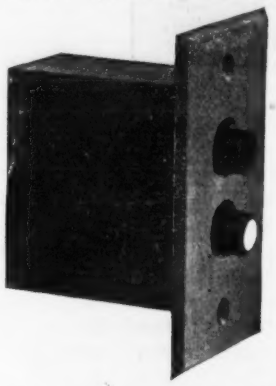
cord. This combination is said to be giving the best of results, the company having succeeded in producing an evenly balanced talking circuit. To a customer this means a good deal, as it insures clear transmission of sound, and gives a telephone that is not liable to get out of order easily.

The transmitters and receivers used are made in Sweden by L. M. Ericsson & Co. The company also makes a variety of other styles for exchanges.

Automatic and Push Button Switch.

With this are illustrated several types of automatic switches and push-button switches, manufactured by F. A. La Roche & Co., Thirteenth and Hudson Streets, New York City. The principle of these automatic switches is that of the "Ideal" circuit breaker of the same makers, namely, the motion is vertical and parallel with the board, on which they are mounted.

By means of this switch a current of any quantity or electromotive force may be controlled from any number of points without the necessity of carrying the main current wires to such several points. The new



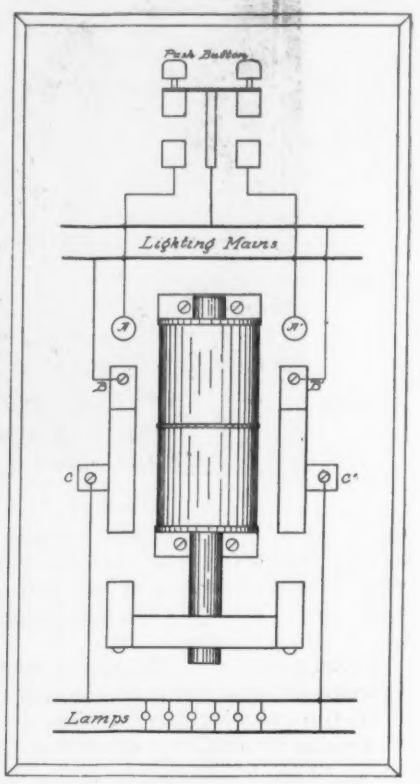


FIG. 1.—PUSH BUTTON SWITCH. FIG. 2.—DIAGRAM OF CONNECTIONS.

automatic switch is as effective and absolute in its action as the best hand switch, and is operated by means of push buttons located wherever it is desired to have control of a given circuit and connected with the automatic switch by means of small wires, as these wires carry but a fraction of an ampere, and only during the time the push button is held in contact.

In Fig. 1 is shown a high potential push button used in connection

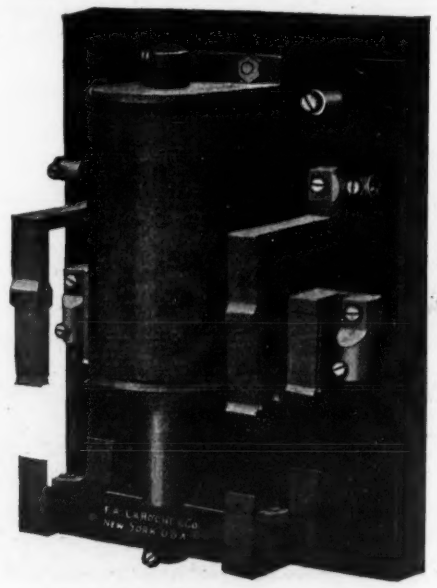


FIG. 3.—TWO-POLE AUTOMATIC SWITCH.

with the automatic switch. The contact is made on carbon points. Fig. 2 is a diagram of the connections of the automatic switch and push button. In connecting up the switch, branches are carried from the branch main to the terminals *B* and *B*, and the lamp circuit is connected to the terminals *C* and *C*. One of the controlling wires for the push button wire, which may be No. 14 or No. 16 B. & S. gauge, is carried from terminal *B* of the switch or from any point of the wiring system feeding this pole of the switch, to the centre

connection of the push button; another wire runs from binding post *A* to the one connecting on the push button, which is on the same

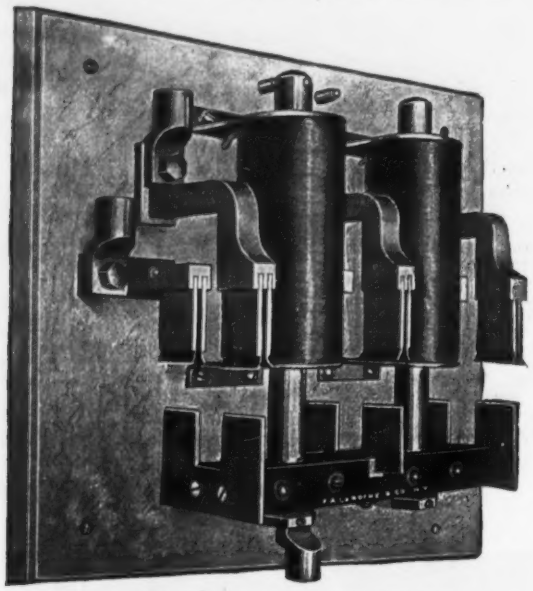


FIG. 4.—THREE-POLE AUTOMATIC SWITCH.

end as the black button; the other wire is carried from binding post *A* to a terminal on the push button, which is on the same end as the white button. When connected up in this manner, by pressing the black button, the lights are extinguished, and by pressing the white button they are lighted.

In Fig. 4 is shown a three-pole automatic switch, which is similar in design and operation to the single or two-pole switches, except that it has two operating barrels; when the button is pressed, the switch must either open or close, depending upon which button is pushed.

Brothers' Electric Cable Crane.

An interesting electric cable system is shown in the accompanying engravings, the invention of William F. Brothers, and manufactured by W. F. Brothers & Co., 43 Dey Street, New York. As will be seen, the cable instead of being secured to a rigidly anchored tower structure is made fast to oscillating shears at either one or both ends. These shears have a counterweight, as shown, sufficient to give the cable the necessary tension for a proper sag when the

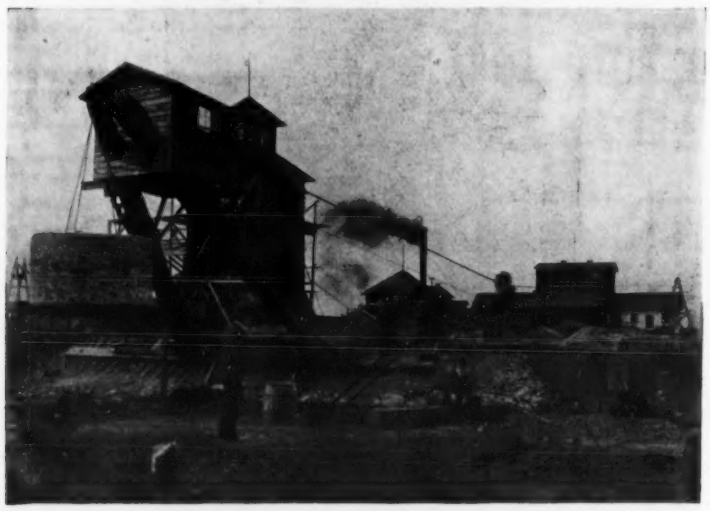


FIG. 1.—ELECTRIC CABLE CRANE.

bucket is midway between the two shears. As the load-carriage approaches either shears, the effect of the counterweight, according to a well-known law, is to decrease the sag of the cable and thereby decrease the end grade. The advantage of this will be apparent when it is considered that with a rigidly anchored cableway the load rarely travels the full length of span between the towers, for the reason that the incline becomes so steep at the end as to require an undue amount of power.

With the advantage just mentioned is coupled another which results in a further saving of power. In a rigidly anchored cable, as the loaded carriage passes along the cable span, the tension of the cable increases as the carriage approaches the centre of the span. With the Brothers' arrangement this result increases the angle of the shears with the horizontal, whereby the counterweight is lifted. In this manner a certain amount of power is stored up, which is entirely due to the descent of the load and does not represent any expenditure of power from the hauling mechanism. As the load carriage recedes from the centre, the energy stored in the counterweight is usefully employed in lifting the load by the amount of sag taken out of the cable as the carriage approaches the terminal.

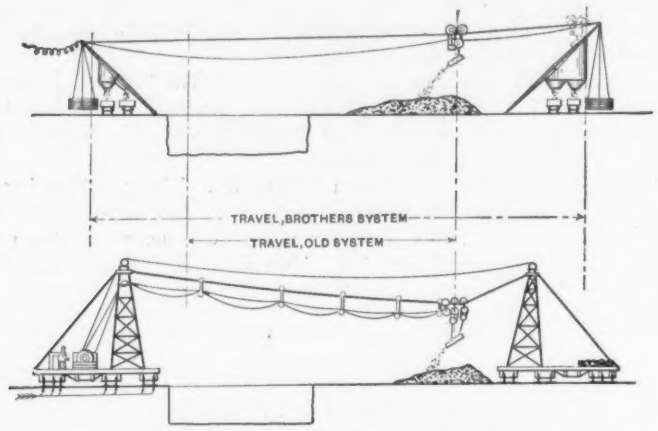


FIG. 2.—SHOWING BROTHERS' AND OLD SYSTEM.

To illustrate this latter point, the case will be taken of a plant in which the counterweight is 66,000 pounds. In actual test it was found that this weight was raised two feet by the movement of the shears in allowing the cable to take its natural sag due to the location of the load. It follows that this 66,000 pounds automatically raised two feet must store energy to the amount of 4 horse-power for one minute, and since the major part of it is available during the last few seconds of the home run, at the rate of about one foot in two and a half seconds it assists the machine with many horse-power and just at a time when excessive power is required. This power is thus stored in going down from one end and is returned on approaching the other end. In addition, not only is the grade lessened, thereby saving brakes in one direction and power in the other, but there is a saving of about 25 per cent in head-room (or height of towers) while the use of full span is possible for loading or unloading beyond the shear foundations.

FIG. 3.—ANOTHER VIEW OF ELECTRIC CABLE CRANE.

Another advantage of the system is that with it the factor of safety is constant, it being impossible to overload or strain any part of the structure. But a single rail is employed for traveling shears, and there are no running ropes, fall-rope, carriers, sheaves, etc., as in the usual type of cable-way.

The electric load carriage is built entirely of steel, which insures an ample factor of safety and brings it down to a minimum weight. All shafting is of turned steel, and the gearing of brass and steel cut.

The motor is a special type and is furnished of any desired power. The machine is always level, no matter at what point of cable. The drivers are very large, insuring the life of cable; they are furnished with sectional tires which are easily replaced at small cost.

It is stated that the operator may be a boy or man, and after the first few hours he can work the machine with great precision and confidence, hoisting, lowering, or dumping, when under full speed. In the trial of a recent plant a round trip was made, touching both towers, in fifty-eight seconds, over 400 feet and return into the house. In this case one end of cable was about 15 feet higher than the other end, and the greatest power of the motor was indicated when about 25 feet from the highest end, which was 75 amperes at 220 volts.

An Improved Rail Joint.

THE accompanying illustrations show a rail joint which has met with much approval in Continental Europe, where it has been adopted for use on a number of steam and electric railways. Recently this joint has been experimented with in this country, and with excellent results, we are informed. As will be seen, it consists essentially of a short length of an I-shaped distance piece between the main rail and an outer piece of rail-like section of the same length, an ordinary fish-plate being used on the inside of the joints. The distance piece, on account of its peculiar shape, distributes the pressure between the main rail and the supplementary rail, and makes a practically rigid joint. By this arrangement it is claimed that the joint is strengthened over the old fish-plate joint by about 80 per cent. Fig. 2 illustrates in an exaggerated manner the effect of strains borne by a fish-plate joint, and will serve to indicate how a similar strain would be met by the new joint without possibility of a like deformation. The short supplementary rail is tapered on the head toward the ends so that the wheels can gradually mount up and run over the surface. The distance piece and supplementary rail are about two feet long, and the latter for a distance of eight inches has a running surface on the same level as the main rail, thus bearing part of the load. It is chamfered at the outer edge so that worn tires can pass smoothly over the joint, this tapering and chamfering being important features of the joint.

The supplementary rail piece can be cut from rails and planed into shape. The distance piece as well as the sole plates can be cast in cases where the cost of cutting rails would not pay. The production of the supplementary rail, distance piece and sole plate by rolling is, however, to be preferred when they are used in quantities. Furthermore, in rolling the supplementary rail, the section can be kept fuller in the head at the upper side, causing it to lie nearer to the main rail than when made from old rails. In cases where the joint is to be fitted to rails partly worn, the employment of equally worn rails from which to make the shape is preferable to the use of new rails, as the cost of planing is saved and the skin formed by rolling is preserved. The customary inner fish-plate remains unaltered in any case. The supplementary rail piece should coincide in height with the main rail, the rolling load then being carried equally by both.

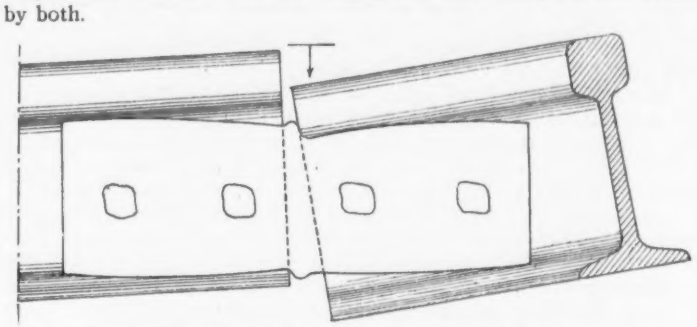


FIG. 2.—EFFECT OF STRAINS ON FISH PLATE JOINT.

The hammering of the ordinary rail joint has often caused the use of heavier rails than would otherwise be necessary. It is claimed that since the rail joint described overcomes these hammerings, the use of more expensive rails is not necessary. Furthermore, that its use involves less wear of tires and less deformation of tread is evident from the fact that a tire receives from 100 to 300 blows per mile at the joints, the effect of which is minimized with the joint described. Among other advantages set forth for this joint are that it insures smooth running over joints, easy travel of rolling stock and considerable reduction of noise. The cost of maintenance is reduced 33 1-3 per cent, and the wearing away of the ends of the rails is completely prevented, thus prolonging very considerably the life of the rail; the creeping of rails is also minimized. When applied to existing tracks, they are strengthened and made capable of carrying increased heavy traffic. Longer rails may be used, thus reducing cost of track, while there is increased safety of running, injury at joints being reduced to a minimum. A particular advantage of this form of joint for electric railways is that the conductivity is much greater. The joint described, which in Germany is known as the "Stossfangschiene" and in England as the "Barschall Joint," is being introduced in the United States under the name of the "Independent Rail Joint," by Max Barschall, 31 Nassau Street, New York. The joint has been laid on 25 miles of line by the Pennsylvania Railroad Co., and is reported by the chief engineer of the road to have proved satisfactory in every particular.

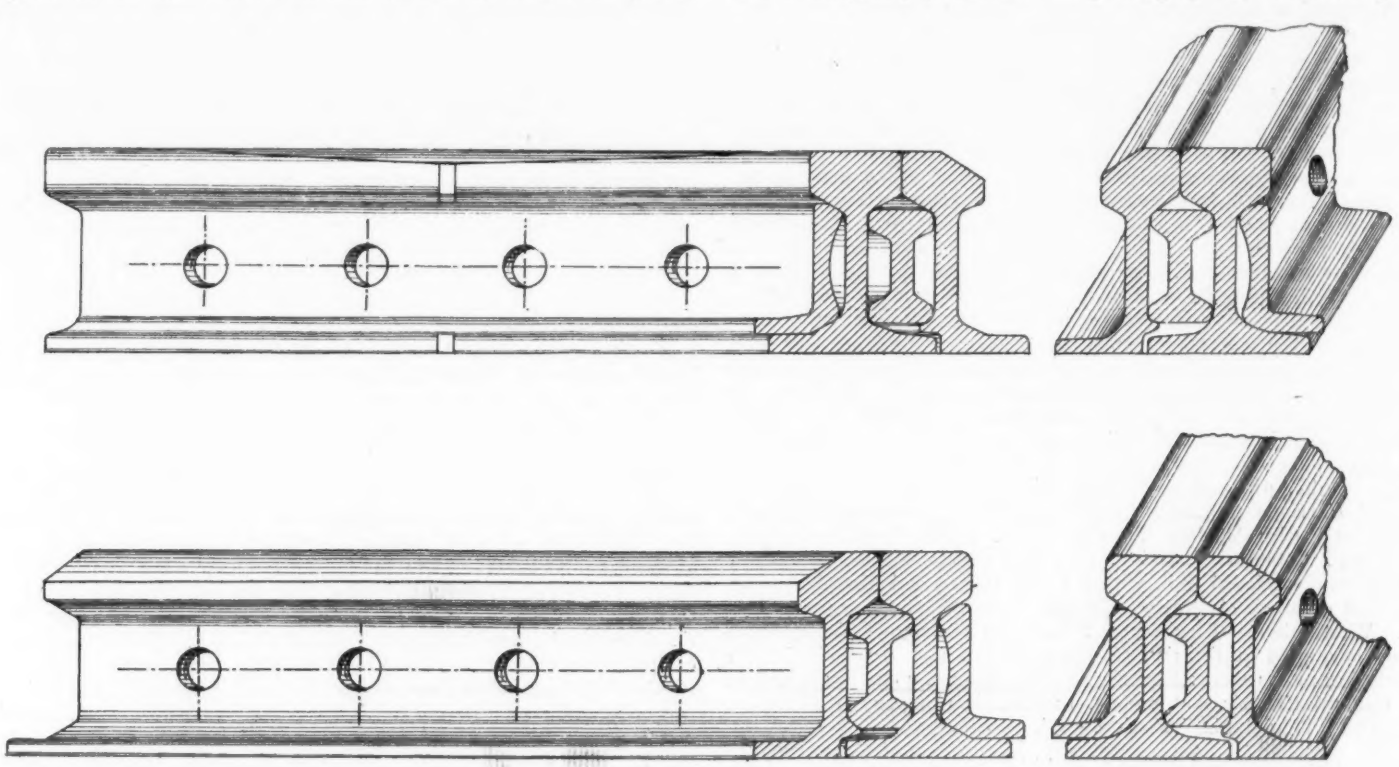


FIG. 1.—IMPROVED RAIL JOINT.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The bank statement last week showed an increase of over $7,000,000 in loans of the Clearing House institutions and a gain of over $4,500,000 in lawful money. The latter brings the surplus up to more than $17,000,000. Money on call closed at 2 per cent. Mercantile paper had some movement, although the demand, which was partly local and partly from out of town, was not wide. The rate quoted is 4 per cent for 60 to 90 davs indorsements. Exports of gold from New York for the week ending Saturday were $1,109,751. The stock market closed dull, the weakness in the industrials having subsided after the unsettling developments in American Steel and Wire. This latter stock declined 3 points on advices from Pittsburg that the Carnegie Company is about to engage in the manufacture of products similar to the staple goods of the Steel and Wire Company. Railroad earnings continue to show gratifying increases, thus reflecting the general prosperity of the country. In the list of electrics, General Electric closed at 137¾, a net loss of 1¼ as compared with the closing price of the week previous. The sales of this stock aggregated 5550 shares. Gen. Elec. pfd. closed at 136¾, Metropolitan Street Railway closed at 159, which was a net gain of 1½ points over the week previous. The sales were 14,593 shares. Third Avenue was weak, closing at 107⅛, a net loss of 4⅜. Four thousand shares of Western Union were sold during the week, the closing price being 82½, which is 1½ points better than that of the week before. Brooklyn Rapid Transit was traded in considerably, closing at 74¾, a net gain of 1¾. The sales aggregated 101,442 shares. The closing quotation of American District Telegraph was 27. In the market for miscellaneous securities considerable irregularity in prices appeared, but it was a fact worthy of note that the most strength was coincident with the greatest activity. There was, in some quarters of the market, a decided disposition to liquidate, and not a few of the net changes for the week were on the side of declines. In a number of issues, however, improvement in price appeared, and not only in actual advances but also in the decided firmness which these stocks showed. General Carriage came again into prominence by reason of renewed inside buying accompanied by a sharp advance. The stock sold as high as 13 and after reacting a point closed at 12 bid, a net gain for the week of 4 points. Electro-Pneumatic made a net gain of 2 points, closing for the week at 3⅝ bid, after selling as high as 3⅞. This stock was favorably affected by the announcement late in the week that a meeting of the stockholders had been called for May 11 and that certain steps looking to the financial rehabilitation of the company had been taken by the directors. It was said further that interests prominently connected with street railway enterprises had secured control of the property. The closing quotations of outside securities were as follows: Electric Boat, 23; do., pfd., 45 asked; Electric Vehicle, 30; do., pfd., 78; General Carriage Co., 12; Ills. Elec. Vehicle Transportation, 1¾; New York Elec.-Vehicle Transportation, 11½; Telephone, Telegraph and Cable of America, 3½; Commercial Cable, 160. The Boston market closed dull, with a heavy tone. Bell Telephone was in active demand, closing at 343, and Erie Telephone is quoted at 103. Westinghouse Electric, 49 asked. In Chicago, Chicago Telephone is quoted at 190 and Chicago Edison, 140. In Philadelphia the closing prices were: Electric Storage Battery, com., 80; do., pfd., 90; General Electric Automobile, 1; Electric Company of America, 11½, and Philadelphia Traction, 96¾.

THE JOHNSON-LUNDELL TRACTION COMPANY, LONDON.—Mr. E. H. Johnson has consummated his arrangements to incorporate a company in England for the purpose of putting on the market Johnson-Lundell apparatus, and the prospectus of the Johnson-Lundell Electric Traction Company, Ltd., has just been published. The capital of the new company is £300,000 divided into 60,000 shares of £5 each, of which 20,000 have been taken by the vendors in part payment. Of the 40,000 remaining shares 14,500 have been applied for by the directors and their friends, rather an interesting statement as showing the confidence of the company and its directors in the system which they intend to advocate. The remaining shares are open to the public and have already been largely subscribed. The company is intended to be a parent company and has been formed to acquire the patents of Messrs. Johnson and Lundell for the manufacture of all kinds of dynamos, electric motors and the Johnson-Lundell conduit system of electric traction. The Lundell motors have already been manufactured in considerable quantities in England by Messrs J. H. Holmes & Co., of Newcastle, and there is a large and growing demand for them. Arrangements have been made by which Messrs. J. H. Holmes & Co. will continue to manufacture dynamos and motors on terms favorable to the company while the erection of proper works is being proceeded with. It is intended also to enter into an arrangement with the Sprague Electric Company of New York to supply motors and controllers and such other apparatus as can for the present best be procured from the United States. Messrs. Holmes & Co. are an extremely well-established and thoroughly reliable manufacturing concern in Newcastle, having large works of their own where they have been manufacturing electric motors and dynamos for some years with great success.

THE UNION TRACTION COMPANY of Chicago has closed a deal with the Consolidated Traction Company of that city, which to all intents and purposes merges the latter into the Union Traction system. The Consolidated Traction Company is granted the right for fifty years to operate its cars over the various lines of the Union Company and to retain for itself 77 per cent of the fares collected, paying the Union Company 23 per cent. In consideration of this privilege, the Consolidated Company gives the Union Company $6,750,000 fifty-year 4½ per cent gold bonds, secured on all property and rights. The principal and interest on these bonds is secured by the Union Company, which guarantees that so long as they are outstanding it will not mortgage any of its property owned at the date of the agreement. The Union Company offers the stockholders in the Consolidated Company $15.00 per share in the above bonds and $1.50 per share in cash, with interest on the bonds from Dec. 1, 1899.

THE CHICAGO EDISON annual report shows a gross income for 1900 of $2,133,827, a net income of $812.390, and a balance after providing for bonds and dividends, of $149,075. Of the latter $60,000 was carried to depreciation and $8,000 to insurance reserve, leaving $81,000 to go to surplus account. The depreciation reserve amounts now to $350,000. The present assets are $11,555,342 of which $10,817,676 represent the plant, $236,485 material and unfinished work, $35,920 accounts and notes receivable, and $65,261 cash. The capital stock is $5,871,000, and bonds and debentures, $4,808,000. The surplus account amounts to $182,773 and insurance fund to $44,000. The business connected on March 31 of this year represents an equivalent of 494,202 16-cp lamps. The regular dividend of 8 per cent was paid during the past year. The report shows an increase of about 10 per cent in net earnings over the preceding year, which year had shown by far the largest increase in the history of the company up to that time.

THE SMITH-VASSAR TELEPHONE SYSTEM.—On Thursday, April 26, quite a number of New York and Western capitalists were represented at a successful practical test of the Smith-Vassar Telephone line at Freeport, L. I. After overcoming much opposition the Smith-Vassar Company has established a permanent line at Freeport, and took the earliest opportunity for giving a public demonstration of the system. The reorganization of the company, in which Gen. Grenville M. Dodge is interested, is now assured. The present capital of $1,000,000 will be raised to $5,000,000 and the new company will number among its officers men who have long been prominent in the financial world.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY has recently had its organization definitely completed, with Isaac L. Rice as president and John N. Abbott, vice-president and general manager. The company is capitalized at $16,000,000, under New Jersey laws and is composed of the following concerns: Electric Axle Light and Power Company, Columbian Electric Car-Lighting and Brake Company, American Railway Electric Lighting Company, European Railway Electric Lighting Company, United Electric Company, Lindstrom Brake Company, and the Railway Triplex Ticket Company.

THE ELECTRIC COMPANY OF AMERICA held its annual meeting in Camden, N. J. on April 24. The following directors were re-elected: A. Louden Snowden, William L. Elkins, P. A. B. Widener, Martin Maloney, Thomas Dolan, William J. Latta, Charles A. Porter, Joseph B. McCaull, James E. Hayes. The companys assets are $3,900,405.35. The net gains during the year were $1,041,-344.33. Dividends amounting to $202,419 were paid, and a balance of $838,925.33 remains as the net profit.

THE EL DORADO POWER COMPANY recently gave notice that a stockholders' meeting would be held in San Francisco, May 21, for the purpose of acting upon the proposal to increase the capital stock of the corporation to the amount of $300,000. A call was also issued for a meeting upon the same date to consider and act upon the proposition to create a bonded indebtedness of $200,000, in bonds of $1000 each, to be secured by a mortgage of deed of trust covering all of the company's property.

BELL TELEPHONE CERTIFICATE OF CONDITION.—The American Bell Telephone Company has filed the following certificate of condition as of date March 27, 1900: Assets—Real estate, $1,271,961; machinery, $16,017; cash and debts receivable, $9,857,289; stock in process, $3,496,678; miscellaneous, $70,975,500; total, $85,617,447. Liabilities—Capital stock, $25,886,300; debts, $14,430,537; reserves, $45,300,610; total, $85,617,447.

THE COMMONWEALTH ELECTRIC COMPANY, Chicago, in its annual report shows an increase of 32 per cent in gross earnings as compared with the previous year, with an increase of 38 per cent in net earnings. Since this company came under the management of Mr. Samuel Insull—about 20 months ago—great improvements have been made in its plant. On March 31 the business connected represented the equivalent of 178,950 16-cp lamps.

CARNEGIE PLANT EXTENSIONS.—A despatch from Worcester, Mass., states that the Carnegie Steel Company has placed an order with the Morgan Construction Company of Worcester for two billet mills and a merchant mill for its plant at Duquesne, Pa. The amount of the contract approaches $500,000 and the order is interpreted as meaning that the Carnegie Company is to become a competitor for the American Steel and Wire Company.

ELECTRIC-PNEUMATIC FINANCES.—The directors and representatives of the reorganization committee of the Electric-Pneumatic Company have arranged for a readjustment of the finances of the company. A stockholders' meeting has been called to take place at Camden, N. J., on May 11, to elect a new board of directors, representing the new interest in control.

DIVIDENDS.—The American District Telegraph Company has declared a quarterly dividend of 1 per cent, payable May 15. The trustees of the Massachusetts Electric Company have declared a regular semi-annual dividend of 2 per cent on the preferred stock, payable June 1.

UNITED RAILWAYS OF ST. LOUIS.—The balance of the securities called for by the certificates of Brown Bros. and the Maryland Trust Company in the United Railways were distributed April 19. This winds up the Browns' connection with the deal, except that there is a small cash payment yet to come.

BELL COMPANY'S NEW STOCK.—In Boston it is rumored that as soon as the new telephone stock is issued for the present American Bell Telephone Company shares, stockholders will have rights to subscribe for $20,000,000 of new stock at par.

WESTINGHOUSE DIVIDEND.—The Westinghouse Electric and Manufacturing Company has declared a quarterly dividend of 1½ per cent on assented stock, payable May 15.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the commercial agencies indicate a generally favorable condition of business, though a falling off in some lines is noted. Excluding the great speculative centres the aggregate of business is larger than it was a year ago. Buying is more careful and conservative; crop prospects in general are very satisfactory, and the fine weather is increasing the general demand. Relatively the best trade comes from beyond the Mississippi and from the Pacific Coast. In the abrupt readjustment of steel and wire prices the iron and steel industry stood the shock very well. The predicted smash in prices of raw material and finished products did not occur. Mr. Edward C. Converse, president of the National Tube Company, speaking of the iron trade situation, is quoted as saying that there is nothing in the future of the iron industry, if people only keep their heads, that is not encouraging, and that is not incident to the business year in and year out. Among the metals copper is firm, while tin is somewhat weaker. The failures of the week, as reported by Bradstreet's, were only 182, an increase of 21 over last week, but two less than in the same week a year ago, and comparing with 245 the corresponding week of 1898, 244 in 1897 and 254 in 1896. On May 1, Bradstreet's says, coal sales agents will mark up prices of steam sizes of anthracite 10 cents to 25 cents per ton. This applies to pea and buckwheat, and is due to the active demand for these sizes resulting from the difficulty in obtaining bituminous coal. Copper is quoted at 17⅛@17½c. for Lake Superior Ingot and 16¼@17c. for casting.

ADVICE OF EXPORTERS TO GERMANY.—Consul-General Mason, of Berlin, Germany, in a report to the State Department points out a number of special considerations that should be kept in mind by manufacturers selling electrical machinery in Germany. He says that in the best constructed electric lighting plants in Germany, particularly in installations for small towns and villages, factories and buildings, storage batteries are employed, and it is customary to run a dynamo for a few hours daily to charge the battery. Consequently, when a 110-volt dynamo is purchased for this service, it must be capable of operating at 160 volts, either by increasing the strength of the field or increasing the speed. There are thus required either a marginal field excitation or a construction that will permit the dynamo to operate satisfactorily at a higher speed and voltage. Mr. Mason says that many American rheostats have been sent to Germany, and that a German type differs very materially from the standards employed in the United States; he has seen a large stock of this appliance thrown back upon the dealers' hands by customers who had ordered them according to German ratings and found on trial that they fell short of their requirements. Another fact he says which detracts from the selling value of American electrical machinery in Germany is the plain, simple type of outward finish. In Germany, rheostats, for example, are mounted between polished pieces of marble or basalt with handsome brass mountings. The casing of motors or of heavy visible parts or dynamos are rubbed and filed clean and smooth and the surface smeared with mastic which is baked to the hardness of enamel, then smoothed, painted, striped and finished, until it becomes decorative. He also says that American electrical machinery is rated higher than is the custom in Germany. Much other useful information, and particularly information relating to German commercial methods is given in the report of Mr. Mason. The report is too long to be reprinted in these columns, but a copy may be obtained upon application to the Bureau of Foreign Commerce, Department of State, Washington. The number of the report is 717.

THE ALABAMA ELECTRIC LIGHT & POWER COMPANY has recently been organized in Montgomery, Ala. The company has already placed contracts for some of its new apparatus, while bids are in order for the remainder. Two 125-hp boilers have been ordered and two non-condensing duplex engines of 125-hp each; also one Goubert heater. The company is now in the market for two deep well pumps and one duplex pump for boiler feeding. The electric plant will include two 90-kw multipolar machines and two exciters. The switchboard will be of white marble, having three panels 6'-6" high by 2½' wide each. All the switchboard instruments will be of the G. E. type. The pole line will be about 15 miles long, with cedar or chestnut poles, which have not yet been ordered, while the wire to be used is to be No. 6 and No. 8 triple braided weather-proof. The station will be about a quarter of a mile from the center of distribution. Already the company reports having secured a ten years' contract from the town council to light the streets, for which service, to begin with, about 40 2000-cp enclosed arc lamps and 300 incandescents will be required. For commercial lighting not less than 3000 incandescents and 25 arc lamps will be required. The officers of the company are: C. G. Albercrombie, president; A. A. Wiley, vice-president; J. W. Parsons, general manager; H. C. Bailey, secretary and treasurer, all of Montgomery, where the chief offices are located, with Prof. A. St. G. Dunstan, principal of the electrical department in the Alabama Technological Institute, Auburn, Ala., as chief engineer.

EXPORTS OF ELECTRICAL MATERIALS.—The following were the exports of electrical material from the port of New York for the week ended April 28: Antwerp—28 cases electrical material, $2406. Argentine Republic—19 cases electrical machinery, $1871; 53 cases electrical material, $6175. British Possessions in Africa—85 cases electrical material, $6266; 48 cases electrical machinery, $13,978. Barcelona—21 cases electrical material, $1399. Brazil—2 cases electrical material, $175. Berlin—55 cases electrical machinery, $1120. British Guiana—1 case electrical material, $55. Bristol—7 cases electrical machinery, $400. Cuba—11 cases electrical material, $94. Canada—2 cases electrical material, $110. Central America—38 cases electrical material, $391. Ecuador—206 cases electrical material, $1953. Genoa—33 cases electrical material, $10,341. Hamburg—52 cases electrical material, $3094. Havre—25 cases electrical material, $5485. Kieff—1 case electrical material, $60. London—339 cases electrical material, $37,402; 63 cases electrical machinery, $13,522. Marseilles—30 cases electrical material, $300. Manchester—6 cases electrical material, $450. Mexico—15 cases electrical switchboards, $2505; 71 cases electrical material, $997. Porto Rico—4 cases electrical material, $54. Peru—28 cases electrical material, $3328. Southampton—11 cases electrical material, $316; 85 cases electrical machinery, $1013. Stockholm—2 cases electrical material, $15. St. Petersburg—9 cases electrical machinery, $519. U. S. Colombia—10 cases electrical material, $383.

BRAZILIAN AND MEXICAN SHIPMENTS.—The Western Electric Company, of New York, has just completed a contract for the extension of the plant of the Para Electric Light Company, of Para, Brazil. Previous to this order the Western Electric Company has furnished the plant over $40,000 worth of supplies, etc. The machinery for the additional equipment of the Para company, which cost some $75,000, consists of two alternating machines having a combined capacity of 515 kilowatts, manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass, and a direct-current 6-pole Western electric machine of 60 kilowatts, together with switchboard and all necessary supplies. The West-

ern company has recently received a substantial contract for the equipment of a large commercial building in the City of Mexico, which is owned by the brother-in-law of the President of the republic, and a contract has lately been executed for the electric lighting of the Panama Railway and Steamship Company's pier at La Boca. The company is also reported to be making good-sized shipments of machinery to Puebla and other parts of Mexico.

THE CENTURY MOTOR VEHICLE CO. has recently been incorporated at Albany to manufacture motor vehicles propelled by steam, electricity and gasolene. The incorporators are Chas. F. Saul, president; Chas. Listman, vice-president; Chas. A. Bridgman, secretary-treasurer; H. C. Plumb and Wm. Van Wagoner, managers. The machines will be manufactured under the patents of the latter. Mr. Saul and Mr. Bridgman were respectively president and secretary-treasurer of the Barnes Cycle Company before the business was sold to the American Bicycle Company. Mr. Van Wagoner was the general superintendent of the Barnes Cycle Company and remained with the American Bicycle Company until March 1, when he resigned his position to perfect the organization of the Motor Vehicle Company. The company has engaged a corps of skilled mechanics, and have leased a manufacturing building at No. 519 East Water Street, Syracuse, N. Y., which they are rapidly equipping, and have a number of vehicles on the floor in the course of construction.

CUBAN ELECTRIC RAILWAY MATERIAL.—The Morris Electric Company, of New York, has just forwarded some 200 tons of material and equipment for the Havana Electric Railway Company. Included in the shipment were 192 trolley poles and 517 pieces of pipe 24 feet long and 3 inches in diameter. The poles and pipe were supplied by the Electric Railway Equipment Company of Cincinnati. Other items were 20 tons of cable manufactured by W. R. Brixey, of New York; a 50-hp engine from the Atlas Engine Works of Indianapolis; a 12-inch centrifugal Morris pump. The value of the shipment is said to have been $24,550. The Morris Company will make another shipment to the same road by the steamer "Mexico," which sails for Havana on the 7th inst., when 100 trolley poles and 276 pieces of pipe from the Electric Railway Equipment Company, 30 tons of Brixey cable, a 20-hp Atlas portable engine, two rock drills from the Ingersoll-Sergeant Drill Company and some stone-crushing machinery will be shipped.

AUTOMOBILES WANTED IN RUSSIA.—The Russian Minister of War desires to purchase a steam or kerosene freight automobile. Consul-General Holloway, at St. Petersburg, writes that the minister proposes that if any manufacturer will ship two such vehicles to St. Petersburg the War Department will pay the freight and duty on both, purchase the one best suited for its purpose and return the other. The machines are to be in St. Petersburg by June, 1900. Manufacturers are invited to send catalogues, giving weight, inside dimensions, price, rapidity of movement and other data, to Col. N. A. Blinoff, Chief Staff, Ministry of War, St. Petersburg, Russia. Mr. Holloway suggests that the possibility for large orders to supply the Russian army, which is scattered over an area more than twice the size of the United States, with automobile wagons, is worthy of attention.

WESTINGHOUSE, CHURCH, KERR & CO., of New York, have received another order for a 2500-hp engine for the Metropolitan Electric Supply Company, of London, in whose power house three engines of the same type have already been installed. These engines are said to cost $48,850 each. The company's recent foreign shipments include three 400-hp compound engines which were forwarded to Russia for use in the generating station of the Odessa Electric Railway Company. The recreation grounds at Mont Dore, one of the most fashionable mountain resorts in France, will soon be electrically lighted by Westinghouse machinery, a 75-hp engine direct-connected to a 50-kw generator having just been shipped to that part of the world.

THE WESTINGHOUSE NEWARK FACTORY.—The Westinghouse Electric & Manufacturing Company will soon reopen its old factory in Newark, N. J. The factory was purchased several years ago from the United States Electric Light Company, and the Westinghouse finally took the business away to its Pittsburg works and closed up the Newark works. Now the company needs more room and is fitting out the old factory with new machinery. The new works will be used for the manufacture of small generators, motors and appliances, for which the demand is constantly growing, and exceeds the supply. It is stated that the new works will provide employment for 300 workmen.

THE AMERICAN TOLL TELEPHONE COMPANY, of Cleveland, O., was incorporated a few days ago with a capital stock of $10,000. Incorporators: W. A. Foss, Edwin F. Kaneen, Albert V. Hageman, L. A. Fanou and B. G. Nichols. The company is organized for the purpose of manufacturing a coin-in-the-slot toll device for telephone recently patented by Mr. Foss. The company is composed of W. A. Foss, president, and Edwin F. Kaneen, treasurer. Its headquarters are at 45 Sheriff street, Cleveland.

A NEW EXPORT TRADE CHANNEL.—United States Consul Kenneday at Para, Brazil, writes that a new line of steamers between New York and Para is to be established. The steamers must make 12 round trips the first year and 24 round trips yearly thereafter, and must have capacity to carry at least 1500 tons of cargo, a speed of no less than 13 knots an hour, and accommodations for 50 first-class and 60 third-class passengers. The new line, with low rates for both cargo and passengers, will be of great benefit to American export trade.

I. ICHEDA, chief engineer of the Osaka Electric Light Company, who, it will be recalled, came to this country some six months ago with Seiza Misaki, the chief engineer of the Harbin Electric Company, has sailed for Europe after a prolonged research into the best electrical methods and practices followed throughout the United States. On his return to Japan Mr. Icheda will submit an exhaustive report to his directors with the result that many American manufacturers may at no distant date find themselves in receipt of some substantial orders.

MESSRS. R. D. NUTTALL & CO., Pittsburg, Pa., are now settled in their new works at Garrison Alley and Duquesne Way. The electrical equipment was furnished by the Westinghouse company and includes two large Westinghouse gas engines of 125-hp. each. These engines drive generators which will supply electric power for motors. All of the machines in the works will be driven by electric motors, doing away entirely with overhead pulleys and belting. The plant is said to be one of the most complete gear cutting establishments in the world.

LONDON COMMERCIAL EXHIBITION FOR AMERICAN MANUFACTURERS.—We are informed by Pitt & Scott, 39 Broadway, New York, that they have already received quite a number of applications for space in the proposed Commercial Exhibition in London of American manufactures. The exact location of the exhibition in London is not yet decided upon, but two or three sites are under consideration and a decision will soon be arrived at. The object will be to fix upon the most central part of London where the necessary space is available.

THE TELEPHONE IN MEXICO.—In the annual report of President Browne, of the Mexico Telephone Company, that gentleman states that the company has suffered loss and the management been subject to much inconvenience on account of unusual delay in receiving material from the United States, caused by the great demand for all kinds of electrical supplies. It has been impossible, he says, to get orders filled for material for several months at a time and delay in receiving long distance instruments has handicapped the company in its efforts to ward off opposition.

CARACAS, VENEZUELA.—The authorities of Caracas have granted an extension of six months to the Caracas Construction Company of New Jersey to complete the electric plant which is to supply electric light to the city and suburbs. This company intends to establish a hydraulic plant of 6000-hp. The electric plant will be established at Macuto, on the seashore, and the power transmitted to Caracas, seven miles distant. It is reported that the company has obtained an option on the tramway company of the city, and intends to apply electric traction.

ENGINES FOR JAPAN.—The Frank M. Pierce Engineering Company, of New York, has received a contract for the supply of two vertical Erie Ball cross-compound high-speed condensing engines of 330 horse-power each, which are intended to be shipped to Japan for the electric light and power plant of the Kawaski dock yards. These engines, which are valued at $14,550, will be direct-connected to Westinghouse generators.

A QUICK PARIS SHIPMENT.—A characteristic example of American enterprise was given in a shipment recently made by Rossiter, MacGovern & Co., to the Compagnie Generale de Traction of Paris. The shipment, which consisted of generators and engines aggregating about 1000 kilowatts, was aboard ship on its way to Paris in less than six days after the receipt of the order.

THE VIRGINIA ELECTRICAL RAILWAY & DEVELOPMENT COMPANY, of Richmond, Va., has recently purchased a large quantity of new machinery from the General Electric Company.

AUTOMOBILE FIRE ENGINE.—Director J. O. Brown, of the Department of Public Safety of Pittsburg, Pa., has advertised for bids for an automobile fire engine, which the department intends to operate in the lower portion of the city.

AUTOMOBILES FOR HAWAII.—A Chicago despatch says that within the last few weeks $50,000 worth of automobiles have been shipped to the Hawaiian Islands. These vehicles were built by a Chicago firm and included cabs, delivery wagons and T-carts.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., contemplate building new shops in the section of the city known as Morningside.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER, April 14, 1900.

WIRELESS TELEGRAPHY AT SEA.—A short time ago it was announced that a few of the North German-Lloyd steamers had been equipped with the Marconi system of wireless telegraphy. A director of the Marconi Company has made the statement that they expect to equip the whole fleet of the North German-Lloyd Company, making it possible, when the system is perfected to carry on a constant communication from ship to ship. It can easily be seen what an advantage this would be in case of fire or accident to any one ship of the fleet, and the possibilities arising are almost beyond imagination.

ABERDEEN'S ELECTRICAL ENTERPRISES.—The city of Aberdeen is so well satisfied with its electric lighting and tramway schemes that it is already feeling much cramped in its present location, and a report by the gas committee has just been adopted, recommending the purchase of a valuable piece of land known as Dee Village for the sum of £8000, on which to erect a new station. At present the electric plant is being worked with non-condensing engines, and it was pointed out that in the new site plenty of water would be available for condensing purposes, and that the new plant could consequently be worked much more economically. The question of installing a dust destructor in conjunction with the new plant will be considered later.

LONDON CORPORATION SUBWAYS.—The provisional passing of the preamble of the city of London (Various Powers) bill has stirred up some of the larger electric lighting companies in London, as an important part of this measure refers to the construction by the corporation of underground subways, in which gas and water mains and all electrical cables will have to be placed, subject to the approval of the all-powerful Board of Trade. As some of these companies have already expended vast sums of money on their own underground installations, they naturally object to being compelled to remove their cables and put them into the corporation subways. The bill will undoubtedly have to undergo modifications before getting through the committee stage.

ELECTRIC POWER DISTRIBUTION.—It is interesting to note that many of the papers published in Great Britain which are in no way devoted to engineering or electrical matters appear to be much interested in the schemes for electric power distribution. Many of these papers see in such schemes a great opportunity to enable the masses of the people to live at some distance from the sources of power and are consequently advocating them. Even such a paper as the *Hospital* has taken up the matter, looking at it from an entirely hygienic point of view, and has published some strong editorials advocating such enterprises which would enable English workmen to live in places which are free from smoke. Coal is the great food by which English industrialism lives, and under the present condition of things the workmen are forced to live in close proximity to the large factories and industries which are massed together about rivers, at the side of coal mines and in great railway centres. In some parts of the country where great industries are situated it is even difficult to see the sun from day to day, and by advocating electric power schemes, papers like the *Hospital* and others see a possibility of many of the factories being operated electrically without the smoke nuisance and a possibility of electric traction, which will convey the workers some miles speedily and cheaply from the centre of their operations.

General News.

THE TELEPHONE.

FLORENCE, ALA.—A telephone line will be constructed from Florence to Rogersville.

GRANITE, ORE.—A telephone exchange is now in operation in the town of Granite, Ore.

PALESTINE, TEXAS.—The Palestine Telephone Company, of Palestine, capital stock $10,000, has been incorporated.

HOUSTON, TEXAS.—The Citizens' Telephone Company, of Houston, has increased its capital stock from $100,000 to $200,000.

SENOIA, GA.—The Senoia Telephone Company has been incorporated by Eugene Row, H. H. Hopple, J. A. Sasser and others.

NOBLESVILLE, IND.—The Telephone Company, of Noblesville, Hamilton County, has increased its capital stock from $5000 to $25,000.

TILLAMOOK, ORE.—The Oregon Telephone & Telegraph Company has been granted a franchise for a telephone exchange in this place.

RALEIGH, N. C.—The Carolina & Virginia Telephone Company has been incorporated by H. P. Strause, F. C. Toepleman and J. H. Bridgers.

RICHMOND, VA.—The contract to build the 65 miles of new telephone line from Richmond to Louisa, on the Chesapeake & Ohio Railway, has been awarded.

NEW RIVER, VA.—The New River Telephone Company has been incorporated by D. F. Hale, H. Chilton, H. H. Hale, all of New Giles. Capital stock, $5000.

GORDON, W. VA.—J. W. Webb has purchased the Gordon Telephone Company's telephone system at Piedmont and surrounding towns and will continue it under the same name.

ELWOOD, IND.—The City Council has granted a franchise to P. F. O'Brien and other home capitalists to erect a telephone plant here, thereby securing connection with Indianapolis.

LOUISA, KY.—A stock company is now being formed to build a telephone line from Louisa to Webbville, following the route of the public road. Fallsburg will also probably be included.

FARMINGTON, ME.—The Franklin Telephone & Telegraph Company, of Farmington, has sold all its rights and privileges to the Eastern Telephone & Telegraph Company, whose headquarters are in Rockland.

ST. ANDREWS, FLA.—The St. Andrews Bay, Chipley & Vernon Telephone Company, under the management of W. A. Emmons of this city, has decided to extend its line from St. Andrews to Milville, on Watson bayou.

CHATTANOOGA, TENN.—The Tri State Telephone & Telegraph Company has applied for a charter, with capital of $50,000. The incorporators are: F. D. Owings, C. F. Newton, G. E. Sage, C. O. Godfrey, John F. McNutt.

GREENFIELD, MASS.—The selectmen have received a petition from the Heath Telephone Company for a franchise to extend its lines from Shelburne Falls to Greenfield, and operate a telephone exchange in that town.

NORTH VERNON, IND.—The Jennings County Telephone Company, North Vernon, has been incorporated. Capital, $6500. Incorporators: C. Wrignt, S. I. Wright, both of Paris Crossing; W. G. Kendrick, of North Vernon.

NEWPORT NEWS, VA.—The Newport News & Richmond Telephone & Telegraph Company, with capital stock of $25,000, has been incorporated by R. P. Orr, W. J. Nelms, G. N. Wise, E. G. Booth and others. Address W. J. Nelms.

TOPEKA, KAN.—The $1,250,000 mortgage on the Missouri & Kansas Telephone Company's property, made to the Old Colony Trust Company, of Boston, was filed here. The Telephone Company owns property in 45 Missouri and 30 Kansas counties.

CHICAGO, ILL.—The "North Office" of the Chicago Telephone Exchange has been removed to the new telephone building, 275 Chicago Avenue. The transfer of the service of the 1800 telephones and 500 trunk lines involved was made without interference to business.

FULTON, MO.—The Fulton Telephone Company has been organized and incorporated for 50 years, with a capital stock of $20,000. The officers are as follows: Tyke Harrison, president; J. V. Kemper, secretary and general manager, and E. W. Grant, treasurer.

HARRISBURG, PA.—The Newton, Ransom & Lake Winola Telephone Company, of Bald Mount, has been incorporated. Capital, $3000. Incorporators: W. A. Hice, C. H. Biesecker, S. Van Sickle, H. S. Cooper, G. W. Biesecker, W. H. Newman, all of Bald Mount.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company is making rapid progress in establishing its independent system in this city. Metallic circuit long distance instruments are being connected at $36 a year for business places and $24 a year for residences. The number of calls is unlimited.

ALBANY, N. Y.—A certificate of dissolution of the Standard Telegraph & Telephone Company, with principal office in Albany, was filed with the secretary of state. The certificate is signed for the company by Jesse N. Trull, president, and George B. Perham, secretary. The directors were mainly eastern men, with headquarters at Lowell, Mass.

FORT SCOTT, KAN.—The owners of independent telephone lines covering eastern Kansas and western Missouri held a convention here on April 10. Reports indicate that the mileage of independent lines is increasing very rapidly, and it has been practically decided that a Maltese cross will be adopted as the sign of all independent toll lines.

LOGANSPORT, IND.—John Holliday Murphy and Wm. Pougue, of Indianapolis, representing the New Independent Telephone Association of the United States, are looking into the feasibility of establishing an independent system in this city. It is understood that one of the two plants here has already been absorbed by its rival, the Central Union.

ASHTABULA, OHIO.—The Ashtabula Telephone Company has decided to declare in addition to the semi-annual dividend of 4 per cent, a dividend of 6 per cent, making a net allowance to the stockholders of 10 per cent for the past six months, to be paid in cash within 60 days; the 6 per cent being the surplus after declaring the regular dividend, the distribution being made at this time on account of an increase in the capital stock from $30,000 to $75,000.

MUNCIE, IND.—At a recent meeting of the Delaware County Farmers' Institute a committee was appointed to draft a plan for the establishment of a telephone system to connect all sections of the county. The committee named the new undertaking "The Delaware County Mutual Telephone Company." The plant will be built by a stock company composed entirely of Delaware County farmers. The price scheduled is $3 per year for each telephone. The general exchange of the company will be in Muncie, with substations at six other towns in the county.

HARRISBURG, PA.—At the recent conference in this city of representatives of independent telephone companies in New York, Pennsylvania, New Jersey, Maryland and Delaware, the plans of the Interstate Telephone & Telegraph Company, recently organized in Delaware, were considered. These plans contemplate the connection of the independent companies in the states named and the establishment of a long distance system. Arrangements were concluded at the meeting for the establishment of this service. The Interstate Telephone & Telegraph Company has contracted to build certain of its lines now and expects, within a reasonable time, to have all the independent telephone companies of New York, Pennsylvania and New Jersey connected. It also expects to make arrangements with the Telephone, Telegraph & Cable Company of America, which will give it communication to all the large cities in the eastern part of the United States.

BOSTON, MASS.—The report of the directors of the Mexican Telephone Company for the year ended Feb. 28, 1900, shows the following results: Telephones in service, 3065; rentals for year, $149,137; gross earnings in Mexico, $160,640; gross expenses in Mexico, $93,251; net earnings in Mexico, $67,383; operating expenses, $71,334; maintenance, $21,916; construction, $34,333; taxes, $7398; net revenue, United States currency, $26,519. The company received 47.10 cents for its silver dollars. The introduction of the metallic system has had the effect of increasing the number of subscribers. During the year active opposition was established in San Luis Potosi, Guadalajara and Zacatecas and extreme measures were adopted to meet it. Rates were reduced several times, and finally free service given before the subscribers who had gone to the opposition companies could be regained.

ELECTRIC LIGHT AND POWER.

HAGERSTOWN, MD.—The city contemplates establishing a municipal electric lighting plant.

NORWALK, OHIO.—The Norwalk Gas & Electric Light Company has been incorporated for $125,000.

THOMASTON, GA.—The city will establish an electric light plant or contract with individuals for lights for streets.

HAMMOND, IND.—The Lake Electric Light Company, of this city, has sold its plant to local capitalists, who also get a seven-years' lighting contract.

UNION CITY, MICH.—Union City is to have a new $6000 municipal electric lighting plant as soon as the specifications can be drawn and the contract awarded.

CHEYENNE, WYO.—The Casper Electric Company, Casper, has been incorporated. Capital, $20,000. Incorporators: C. H. King, F. Salathe, T. M. Becker, all of Casper.

CONCORD, N. H.—Spence & Cooms, of Somersworth, have secured a contract for a dam and other stonework for a big electric light and power plant at Sacarappa, Me.

MEMPHIS, TENN.—W. H. Walker, formerly in the electrical business in this city, has leased the electric lighting plant at Sheffield, Ala., and is now operating the same.

VERSAILLES, IND.—The City Council has voted the electric light plant project through and the contract given to Grant Johnson. The plant is to be in operation Sept. 1.

HAGERSTOWN, MD.—Mr. James E. Hewes, of Baltimore, has been appointed to prepare plans and specifications and superintend the construction of Hagerstown's electric light plant.

GENESEO, N. Y.—The Geneseo Gas & Electric Light Company has made a proposition to the village for the sale of this plant for $25,000. There is a likelihood of the acceptance of the offer.

SYCAMORE, ILL.—The Sycamore Electric Light Company has gone into the hands of a receiver, Cassius M. Conrad being appointed. He will sell the plant at public auction on May 2.

HARTFORD, KY.—An electric light and power paint is much needed in this place. Mr. J. M. Mattingly, president of the Commercial Telephone & Exchange Company of this city may be addressed on this subject.

AUSTIN, MINN.—The electric light plant owned by the General Electric Company, of Schenectady, N. Y., was sold to the city of Austin for $16,000. About 100 arc lights will be placed around the city at once.

FOSTORIA, OHIO.—The City Heat & Light Company is a defendant in a suit brought against it in the Circuit Court by B. W. Gilbert, of Boston. Gilbert seeks to enjoin the company from selling the property or dismantling the plant.

EDINBURG, IND.—This village of 2000 people owns an electric light plant and furnishes light to dwellings for 15 cents a lamp per month. Business places pay 20 cents a month per light. The village also owns the water-works system.

WESTWOOD, N. J.—The Union Electric Light Company, Westwood, has been incorporated. Capital, $25,000. Incorporators: G. M. Ottignon, J. J. Bate, both of Westwood; G. Davidson, of Hackensack; J. J. Bate, attorney, New York

LEADVILLE, COLO.—The Leadville & Red Cliff Water, Light & Power Company, Leadville, has been incorporated. Capital, $650,000. Incorporators: C. Bettcher, S. W. Mudd, W. B. Page, J. F. Campion, C. Cavender, all of Leadville.

ALLIANCE, OHIO.—The Alliance Gas & Electric Light Company has decided to bring suit against the city of Alliance to enjoin it from erecting a municipal electric lighting plant. The company claims to have a perpetual franchise.

CHICO, CAL.—The Chico Gas, Electric Power & Lighting Company, Chico, has been incorporated. Capital, $100,000. Incorporators: P. Henshaw, T. N. Crew, A. F. Johns, O. L. Clark, T. Bishnell, E. B. Collins, E. Meybern, all of Chico.

PORT WASHINGTON, N. Y.—The Port Washington Electric Light, Heat & Power Company has been incorporated. Capital, $7500. Directors: Charles F. Lewis, L. B. Small, J. O'Brien, John J. McDermott and John H. Burtis, of Port Washington.

BALTIMORE, MD.—The Delaware & Susquehanna Electric Light Company, of Cecil County, Md., has been incorporated, and has power to build a railway from the Susquehanna River to the Delaware state line. It can also manufacture and sell electricity.

SAN ANTONIO, TEXAS.—The San Antonio Gas & Electric Company, San Antonio, has been incorporated. Capital, $200,000. Incorporators: E. H. Jenkins, A. W. Houston, R. Houston, all of San Antonio; W. F. Douthirt, E. McMillin, of New York City.

INDIANAPOLIS, IND.—The County Council of Marion County has appropriated $134,000 for the construction of a county power house, electric light plant and tunnel for use of the county buildings. The machinery and equipments will cost, as estimated, $98,000.

ST. PAUL, MINN.—The St. Paul Edison Electric Light Company is now engaged in installing three miles of underground cable for its 2500-volt transmission line. The work will be finished by August. Overhead lines are used from Apple River to the city limits, a distance of 25 miles.

HAGERSTOWN, MD.—Mr. James Ellicott Hewes, of Baltimore, held a long conference with the city officials regarding the municipal electric lighting plant to be established here. Mr. Hewes estimates that a plant sufficient for the needs of Hagerstown can be introduced for $35,000 or $40,000.

WAPAKONETA, OHIO.—A recent report of the municipal electric light plant covering a period of four years shows that the plant has netted 13 per cent on the investment. The cost of lighting 75 arc lights during the past year, after deducting receipts for incandescents rented, was $28.18 per lamp.

BURLINGTON, VT.—The Vermont Electric Company has purchased water rights up the Winooski River. A dam will be built across the river at a point where the rapids are strongest and a power house located there. This, with the present power furnished, will give a capacity of 5000-hp at the lowest water.

LOGANSPORT, IND.—Muncipal ownership and management of the electric light plant is figuring in the election to be held in May. There is a wide diversity of opinion as to the method of operation, and the price per 1000 watts for the incandescent lighting service. The income from the plant has not been sufficient to meet expenses.

MARION, IND.—The Marion Electric Company is in the market for generating apparatus of 140-kw capacity, divided in two units of 40 kilowatts and 100 kilowatts. Engine type machines are wanted. The company will build a brick power house, but as yet the specifications have not been given out. It expects to have its plant in operation by Aug. 1.

SPRINGFIELD, S. D.—The artesian well which has heretofore been the sole source of power for the electric lighting plant of Springfield, S. D., weakened in flow to such an extent that it has become impossible to keep up the lights. After two weeks of kerosene oil lighting a 34-hp gasoline engine was installed which, together with the artesian well, furnishes ample power.

ST. LOUIS, MO.—The assessments on personal property of the following corporations were made by the St. Louis board of equalization at a meeting April 14: Bell Telephone Company, $808,700; Imperial Electric Light Company, $90,000; Missouri-Edison Electric Light Company, $338,000; Electric Illuminating Company, $90,000; Laclede Gas Light Company, $1,000,000

JEFFERSONVILLE, IND.—The municipal ownership muddle promises to leave this city in total darkness for an indefinite period after next meeting of the council. A Fort Wayne company for several months has been leisurely constructing an electric light plan, with a view of selling to the city. The city campaign is on. Municipal ownership is the whole issue and party lines will be obliterated.

INDIAN HOOK SHOALS, S. C.—The Catawba Power Company will soon let the contract for the construction of a dam and power house. The dam will be of stone, 20 feet high and over 400 feet long, and the power house will be of brick, 34 by 134 feet in dimensions, and equipped with water wheel and electrical apparatus. Mr. William C. Whitner, Andersonville, S. C., may be addressed for further information on the subject.

CINCINNATI, OHIO.—The title to the property recently purchased by the Cincinnati Edison Electric Company in this city on the south side of Government Square has been cleared up. The company will now proceed with the work of construction of the handsome building to be erected on the site. The building will be very strong and absolutely fireproof and in the basement will be located a storage battery that will cost over $100,000. Manager White, of the concern, has made a splendid record since his assumption of the reins of direction about three months ago.

BALTIMORE, MD.—The Municipal Subway Commission, of Baltimore, consisting of Mayor Hayes, City Register George N. Numsen and Mr. A. R. Cathcart, president of the Board of Fire Commissioners, met on May 1, to arrange for having the wires placed in the conduits in the sections where the conduits have been completed. In a short time the city's conduits will be ready for the telephone, telegraph and electric light wires in the business portion of the city. The only wires to remain up will be the trolley wires of the United Railways & Electric Company.

ROCKVILLE CENTER, L. I.—The Board of Village Trustees has sold $16,500 village bonds for extending and increasing the electric light plant. The improvements will consist of the addition of two 200-hp boilers, a 200-hp automatic cut-off non-condensing engine and a 2000-light, 16-cp alternator In connection with the present plant this will give the village a duplicate plant. There is much demand for commercial lights here and the plant is overloaded now. Many street lights have been cut out and many applications for light in dwellings are on file, but cannot be granted.

THE ELECTRIC RAILWAY.

ALBANY, N. Y.—The United Traction Company, of Albany, paid a quarterly dividend of 1¼ per cent on May 1.

SPRINGFIELD, MASS.—The Lenox Street Railway Company has been granted the franchise for which it asked in that town.

BAY CITY, MICH.—The Bay Cities' Consolidated Street Railway Company will build a $50,000 power house this spring at Bay City.

NEW ORLEANS, LA.—The ordinance accepting the bid of the St. Charles Street Railroad for a street railway franchise was adopted.

EASTON, PA.—The construction of the proposed trolley road between this city and Nazareth is assured, the contract having been awarded to B. F. Sweeten & Son, of Camden, N. J.

YOUNGSTOWN, OHIO.—The Mahoning Valley Electric Railway Company began improvements on all its lines at Youngstown, Ohio, which will aggregate an expenditure of $100,000.

NEW YORK, N. Y.—The highway commissioners of Harrison have granted a franchise to the Larchmont Horse Railroad Company to run an electric railway in Halstead Avenue, to the Mamaroneck line.

RICHMOND, VA.—A consolidated mortgage was filed on April 16 in the chancery court by the Richmond Passenger & Power Company for $3,000,000, with the Merchants' Trust Company, of New York, as trustee.

RED WING, MINN.—The directors of the Red Wing & Trenton Transit Company elected the following officers: President, E. H. Blodgett; vice-president, Peter Nelson; secretary, L. C. Smith; treasurer, W. H. Putnam.

KANSAS CITY, MO.—The promoters of the electric line from Rosedale to Olathe, Kan., which is proposed to connect Kansas City with the latter place, have secured a 20-year franchise from the county board of Wyandotte County.

CAMDEN, N. J.—A large majority of the stock of the Camden, Woodbury & Gloucester Traction Company has, it is said, been purchased for men connected with the North Jersey Street Railway Company and other trolley organizations.

WILMINGTON, DEL.—Chancellor Nicholson granted a preliminary injunction restraining the Wilmington & Brandywine Springs Railway Company from laying its tracks on West Sixth Street, thus preventing the road from entering the city.

MARLBORO, MASS.—The Marlboro Street Railway, which consists of the Marlboro & Hudson and the Framingham, Southboro & Marlboro street railways, has been sold to James F. Shaw & Co., who have had an option on the road for several months.

POTTSTOWN, PA.—Right of way is being obtained through Trappe, Limerick and Lower Pottsgrove township for a trolley line between Collegeville and Sanatoga, which will complete the electric railway system between Philadelphia and Pottstown.

SAN ANTONIO, TEXAS.—The San Antonio Traction Company, San Antonio, has been incorporated. Capital, $200,000. Incorporators: E. H. Jenkins, A. W. Houston, R. Houston, all of San Antonio; W. F. Douthirt, E. McMillan, of New York City.

INDIANAPOLIS, IND.—The Wabash River Traction Company, Wabash, has been incorporated. Capital, $20,000. Incorporators: D. A. Blacksbee, F. C. Boyd, D. W. Blacksbee, J. S. Bradley, all of New Haven, Conn.; N. G. Hunter, of Wabash, Ind.

NEW HAVEN, CONN.—It is reported that the Young syndicate has for some time been trying to secure control of the Hartford Street Railway Company. The company owns 62.5 miles of track in Hartford and its suburbs, and leases nine miles in addition.

CHICAGO, ILL.—Long-standing dissensions as to the management of the Chicago General Railway Company came to a crisis on April 14, when John W. Witbeck, ex-president of the company, filed a bill for the appointment of a receiver before Judge Tuthill, of the circuit court.

VALPARAISO, IND.—The Valparaiso-Porter-Chicago-Chesterton Interurban Street Railway Company has filed articles of incorporation in the State of Delaware. Capital stock, $250,000. Similar articles will be filed in Indiana, and work on the proposed lines will be begun in a few weeks.

EL PASO, TEXAS.—The El Paso & Juarez Traction Company, with principal offices in El Paso, Texas, has been incorporated. Capital stock, $200,000. Incorporators: J. T. Terry, of New York City; Anson Mills, of Washington, D. C.; Max Weber, Joseph McGoffin and John A. Happer, of El Paso.

DOYLESTOWN, PA.—The Doylestown & Willow Grove Trolley road was recently transferred to William C. Ryan, of Doylestown, who purchased the road, March 14, at public sale, for $50,000. It is generally supposed that Attorney Ryan is acting for parties identified with the Union Traction Company.

GRAND RAPIDS, MICH.—C. H. Lawrence and G. W. Moran, of Detroit electric railroad builders and engineers, took a preliminary look over the proposed line from this city to Grand Haven and Muskegon. They say that the $730,000 capital is now ready, and work upon the line will be pushed at once.

SAN ANTONIO, TEXAS.—At a meeting of the city council right of way over certain streets of the city was granted to the San Antonio & Brownsville Railway. This road is to be nearly 200 miles in length, and will pass through the virgin country between this city and the mouth of the lower Rio Grande at Brownsville.

GREENSBURG, PA.—The Connellsville & Uniontown Electric Railway Company will build a power house to cost $230,000. The road is to be extended from Mt. Pleasant to Fairchance. The plans also include a line from Scottdale to Pittsburg, via West Newton and Monongahela City. The right of way has all been secured.

HARTFORD, CONN.—The New England Street Railroad Company, of Boston, which owned the Winchester Avenue electric road in New Haven, sold the road to I. A. Kelsey, representing A. M. Young, who has been securing control of other Connecticut roads recently. The Winchester Avenue road has 25 miles of main line and branches.

ST. LOUIS, MO.—On April 17 the employees of the northern division of the St. Louis Transit Company presented their retiring division superintendent, Jos. S. Minary, with a handsome set of diamond shirt studs as a token of the esteem in which he is held by the men over whom he has been superintendent. The presentation was made by A. W. Morrison.

SEYMOUR, IND.—The commissioners have granted a franchise to the Seymour Southwestern Electric Railroad through the county north to the Bartholomew County line and southwest through Brownstown, Vallonia and Medora to Sparksville, and south to the Washington County line. The company has asked for a franchise through Washington and Orange counties, and thus reach West Baden.

DALLAS, TEXAS.—At the annual meeting of the stockholders of the Dallas & Oak Cliff Electric Railway the old officers were re-elected, as follows: H. C. Scott, St. Louis, president; Thomas H. West, St. Louis, secretary and treasurer; B. F. Sibert, Dallas, superintendent; Edwards Whitaker and H. C. Haarstick St. Louis, and Royal A. Ferris, De Edward Greer and C. F. Carter, Dallas, directors.

UXBRIDGE, MASS.—The Uxbridge & Blackstone Street Railway Company is being formed under the laws of Massachusetts. The capital stock of the company is to be $80,000. The present directors are John E. Sayles, of Uxbridge; Isaac T. Holman, of Millville; M. P. Burbank, of Whitinsville; Edward J. Priest, of Uxbridge; W. H. Tyler, of Worcester; T. S. Johnson, of Worcester; F. H. Viele, of Worcester.

ST. LOUIS, MO.—A petition was presented to the St. Louis county court April 16 by the St. Louis, Fenton & Southwestern Railway Company, asking an extension of time in which to finish laying its tracks. The franchise provided that the work should be completed by April 24, 1900. The company claims that it has complied with every requirement except the completion of the road. Lack of funds has delayed it in this work. That has now been overcome, and it wants one year more time.

ALBANY, N. Y.—The Buffalo, Niagara Falls & Rochester Railway Company was incorporated April 16, with a capital of $1,250,000. The company is to construct a street surface road 120 miles long, which may be operated by horse, cable, electricity or compressed air power, and will run through Monroe, Orleans, Niagara and Erie counties. The directors are Allan C. Beach, of Watertown; Charles S. Baker, George L. Brown, George Moss, Milton Clark, George A. Brooks, Henry D. Quinby and William C. Gray, of Rochester, and William H. Gillette, of Charlotte.

THE AUTOMOBILE.

THE EMPIRE STATE AUTOMOBILE COMPANY, of Rochester, N. Y., has been incorporated. Capital, $20,000, and directors: Martin F. Pinckney and George E. McElroy of Rochester.

THE KOKOMO AUTOMOBILE COMPANY, of Kokomo, Ind., will have an exhibit at the Paris Exposition, in charge of Laey Potter. The Kokomo company claims to hold the champion long-distance record of the United States.

THE PARRY AUTOMOBILE COMPANY, of Indianapolis, has purchased a site of 54 acres and the construction of new buildings will begin at once. One million dollars will be expended. The company, it is stated, is already receiving large orders from this and foreign countries.

AUTOMOBILE SERVICE IN NEW YORK CITY.—Governor Roosevelt has signed the bill which permits the Fifth Avenue stage line, which is owned by the New York Electric Vehicle Transportation Company, to extend its service below Eighth Street and above Eighty-ninth Street, in Fifth Avenue.

NORFOLK, VA.—The Corporation Court, of Norfolk, has granted a charter to the Motor Bicycle Company for the manufacture of automobiles, with an authorized capital of $15,000,000. Ansel L. White, of Brooklyn, is president of the company, and Benjamin J. Downer, of Montclair, N. J., and Frederick Stewart, of New York, secretary and treasurer, respectively. These, with Ernest Hopkinson, of East Orange, N. J., and Joseph Kling, of New York, compose the board of directors.

AUTOMOBILE CLUB IN COLUMBUS, OHIO.—A preliminary meeting for the purpose of forming a club, to be known as the Automobile Club of Columbus, was held in Columbus, Ohio, a few days ago. The organizers are: Dr. C. M. Taylor, Oscar Lear, S. W. Hempstead, Thomas Midgeley, Campbell Chittenden, H. B. Armstrong and Dr. Schueler, owners of automobiles in that city. A resolution was adopted to the effect that an ordinance should be passed by the City Council limiting the speed of automobiles to 12 miles an hour. The club will hold a parade in the near future.

PERSONAL.

MR. C. W. COBB, the subject of the accompanying portrait, will need no introduction to the electrical fraternity west of the Mississippi. As traveling representative of the Electrical Supply Company (afterward the Ansonia Electric Company), Mr. Cobb for three years traveled through the Northwest and Pacific Coast states. About six years ago he became connected with the Central Electric Company and covered for it the great stretch of territory west of the Mississippi River, from the City of Mexico to Victoria, B. C. During the past year Mr. Cobb has been located in Chicago as general salesman of this company, from which position, however, he has just resigned to become the sales manager of the Chicago Mica Company. Few men, if any, in the electrical trade have a wider acquaintance than Mr. Cobb, and none is more popular with the electrical fraternity. His knowledge of the requirements of the electrical trade will no doubt prove of great value to the Chicago Mica Company.

C. W. COBB.

MR. PATRICK KENNEDY has been appointed chief engineer of the Consolidated Railway Electric Lighting & Equipment Company, with headquarters at 22 Thames Street, New York.

MR. EDWIN HOLMES, president of the Holmes Electric Protective Company, of New York, on April 25, celebrated his eightieth birthday. He first introduced the burglar alarm in New York in 1858.

MR. E. M. HAGAR, who formerly represented the Southwark Foundry & Machine Company in Chicago, and later represented the C. & G. Cooper Company in the same city, is now manager of the cement department of the Illinois Steel Company. This company now has two mills with a capacity of 2500 barrels per day, making from blast-furnace slag a high grade of hydraulic cement, well suited for use in foundations for heavy loads, such as engines, for dams and hydraulic work and for underground conduits. This material is termed "Steel Portland Cement."

NEW INDUSTRIAL COMPANIES.

THE H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY, of Syracuse, N. Y., has been incorporated. Capital, $10,000. Directors: Moses L. Oberdorfer, Holden P. Cameron and Frederick T. Pierson, Syracuse.

THE BATAVIA RUBBER TIRE COMPANY, of Batavia, N. Y., has been incorporated. Capital, $50,000. Directors: Frank Richardson, William C. Gardiner, William W. Leavenworth, Alva M. Colt and John N. Sweet, Batavia.

THE BOOKER CARBON AND BATTERY COMPANY applied for incorporation in St. Louis, Mo., April 25, with a capital stock of $50,000, one-half paid up. The incorporators are S. G. Booker, Michael Horan, Jules Creissen, Fred T. Stephenson and William L. Booker.

THE CUBA COMPANY, with an authorized capital stock of $8,000,000, of which $2,500,000 already is subscribed for, was incorporated in Trenton on April 25. The incorporators are W. C. Van Horne, Levi P. Morton, W. C. Whitney, Thomas Ryan, C. G. Hanen, E. A. Harriman, James J. Hill, William L. Bull and H. L. Terry. The company is to operate steam and electric railways in Cuba.

LEGAL.

ALLEGED INFRINGEMENT OF CONTROLLER PATENTS.—The Thomson-Houston Electric Company has brought suit in New York against the Sprague Electric Company, for infringement of the series-parallel controller patent. The alleged infringing devices are claimed to be in use upon the Sprague trains tested in the recent trials by the Boston Elevated Railway Company and in Brooklyn.

Trade Notes.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, has recently appointed Messrs. Shipman and Perrine its agents for Kansas City. Their offices are in the New York Life Building.

THE TELEGRAPH INSTRUCTOR.—The Western Electric Company has recently brought out a new book, entitled "The Telegraph Instructor," by G. M. Dodge. The book is said to be simple and practical.

A. O. SCHOONMAKER, 158 William Street, New York, makes a specialty of mica washers and bushings for gas engine and arc lamp manufacturers. He will furnish samples free of charge to those wishing to give them a trial.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, reports increasing sales of Adams-Bagnall arc lamps. This the company attributes to the simplicity of construction of the lamp, which has become quite a favorite with station managers.

THE DONNELLY IMPROVED STEEL CLIMBERS sold by J. J. Reidy, New Haven, Conn., have been adopted by the Southern New England Telephone Company, Western Union Telegraph Company and the Postal Telegraph-Cable Company.

REMOVAL.—The Berlin Iron Bridge Company, of East Berlin, Conn., removed its New York office on May 1 to the St. Paul Building, 220 Broadway. Mr. Seymour N. Robinson, its New York representative, will continue to be in charge of the office.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, 125 White Street, New York, has just received an order for 25,000 miniature lamps to be shipped to Paris, France. This is said to be one of the largest export orders ever given in this line.

MR. JACOBS, manager of the Triumph Electric Company, Cincinnati, recently returned from a three-weeks' business trip among the trade centres of New York, Washington, Baltimore and Philadelphia. He reports much inquiry, and that business, considering the time, keeps up very good.

"DIAMOND H" SWITCHES.—The Hartford Manufacturing Company, Hartford, Conn., has issued a neat catalogue of its "Diamond H" push-button switches. The various styles of these switches are illustrated, and views of their mechanism and the component parts are also shown.

THOMPSON, SON & CO., dealers in new and second-hand machinery, 107 Liberty Street, New York, have established a branch house in London, England, at 39 Victoria Street, to facilitate the handling of their rapidly growing export trade. It will be conducted under the management of Mr. W. H. Merriman.

MESSRS. CHAS. H. BESLY & CO., 10-12 North Canal Street, Chicago, carry a complete stock of Pecora machinery paints which have been on the market and given excellent satisfaction since 1862. The firm's May catalogue is now ready for distribution, and a copy will be mailed to any address free on application.

CLING-SURFACE, the manufacturers report, does not stop the slipping of belts by making them stick to the pulleys and so requiring power to free the belt as it leaves the pulley, but it allows the belt to cling to the pulley without sticking. They also report that its preservative quality is perfect and prolongs a belt's life at least threefold.

STORAGE BATTERIES IN LIGHTING AND POWER STATIONS.—The Electric Storage Battery Company, of Philadelphia, has just issued a circular describing and illustrating the electrical equipment of the Peekskill Traction Company, of Peekskill, N. Y. A curve shows the load on the line and the load on the generator, and is very instructive.

W. E. CEILING FANS.—The Linz Building, Dallas, Texas, a handsome brick and stone building of modern construction, contains, it is said, the largest installation of chandelier ceiling fan motors in the world. One hundred and thirty-nine W. E. Standard ceiling fan motors are being used. These fan motors are illustrated and described in bulletin 24-F, issued by the Western Electric Company.

THE MAXWELL M. MAYER ELECTRIC COMPANY has opened a salesroom at 123 Liberty Street, New York, where its machines for plating, lighting and power are on exhibition and in operation. This company has given especial attention to plating machines, and its salesroom will be well worth visiting. All correspondence should be addressed to the factory, 2369 Second Avenue, New York, as heretofore.

THE PHOENIX ELECTRIC TELEPHONE COMPANY, 445 Greenwich Street, New York, has recently increased its facilities and reduced prices to a point where it can compete even with the cheaper grades of goods now in the market. After a sharp competition this company secured an order for a complete 400-capacity exchange for the South Carolina Telephone Company, in Columbia, S. C., and is now shipping the instruments.

MACHINE TOOLS.—The "1900" catalogue of the Garvin Machine Company, New York, contains considerable new matter. Seventeen pages contain specifications of new tools, and many of the machines shown on other pages have been rebuilt from entirely new patterns involving new improvements. The reading matter in the catalogue is in excellent form, the specifications accompanied by illustrations giving as nearly a perfect idea of a tool as is possible in print.

THE VICTOR ELECTRIC COMPANY, of Chicago, is now building igniters for use in automobiles. The company's special work in the past has been the construction of small motors from 1-20 horse-power to 1 horse-power, rotary transformers, etc., which lines it still continues to manufacture. Its motors are largely used by dentists, jewelers and surgeons. Mr. C. F. Samms, vice-president of the company, has just returned to Chicago from a successful trip in New York and the East.

THE IRONCLAD RESISTANCE COMPANY, of Westfield, N. J., manufacturers of field rheostats, theatre dimmers and other electrical apparatus, reports rapidly increasing demands for its goods in the foreign market. Its London branch, formerly at 5 New Compton Street, W. C., was quite inadequate for the handling of its business and its new office and warehouse, situated at 57 New Compton Street, are replete with all conveniences. It there carries constantly a full line of its various products. Mr. Douglas C. Bate is the manager of this agency.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, 831 Arch Street, Philadelphia, announces that Mr. W. W. Burnham, formerly with the Electric Gas Lighting Company, of Boston, is now connected with the business. Mr. Burnham will take charge of the house goods and electric gas-lighting department, and his 18 years' experience will certainly make him a most valuable assistant. Mr. H. C. Roberts also announces that he has established an office at 603 Fifteenth Street, N. W., Washington, D. C., and placed it in charge of Mr. James Kennedy.

THE STANDARD AUTOMATIC GAS ENGINE COMPANY, at present of Oil City, Pa., has about completed arrangements for the erection of a plant at Youngstown, Ohio. Plans have been made and bids asked for the erection of a factory building, 80 x 400, and upon the estimated cost of the building will depend the moving of the plant. The company manufactures engines for all purposes except reversible hoisting engines, and makes a specialty of building engines for street railway, electric light and power plants, air compression, refrigerating plants, etc.

PNEUMATIC TOOLS AT PARIS.—T. P. Kimman, assistant mechanical superintendent of the Standard Pneumatic Tool Company, Chicago, has sailed for Paris, in order to install and operate the company's "Little Giant" pneumatic tools and appliances at the Paris Exposition. There will be a complete air plant in actual operation in the Champ de Mars and Park Vincennes, demonstrating the adaptability of pneumatic tools to various classes of work, and showing the development of this class of machinery. It will be a novel and interesting exhibit and one that will redound to the credit of America.

MR. E. V. BAILLARD.—This gentleman's business has so increased that he has outgrown his old quarters at 106 Liberty Street, and moved to the Fox Building, Franklin Square, New York, where he has much more room and better facilities for carrying on his work. Mr. Baillard is putting in new machinery and will shortly have a line of new scientific instruments ready for the market. Besides other specialties he will have the farad-meter, described by Dr. Pupin at the February meeting of the A. I. E. E. Mr. Baillard is taking orders for this instrument now, and is ready to make anything new in that line.

THE GOUBERT MANUFACTURING COMPANY has been compelled, by reason of the steadily increasing demands for its specialties, to greatly increase its manufacturing plant and secure larger office accommodations. It has accordingly taken commodious offices at 85 Liberty Street, New York, where it will be "at home" after May 1, to both old and new patrons. The past year has been one of the most successful in the history of the company, orders being larger and more numerous. It has established an entirely new plant at Bayonne, N. J., which it has thoroughly equipped throughout with the most modern machinery, for the better production of its specialties.

GENERAL ELECTRIC CATALOGUES.—The General Electric Company has recently issued two new catalogues and a bulletin. The catalogues are on the subject of General Electric direct current fan motors and General Electric, type H, oil transformers; the bulletin relates to induction potential regulators. The catalogues are gotten up in the company's usual artistic fashion and both are profusely illustrated with half-tone cuts showing the apparatus described. Curves are given exhibiting the performance of transformers submitted to tests. The transformer booklet gives some valuable information on the subject of these devices, which will make it valuable for reference.

IMPULSE WHEELS FOR UTAH.—The American Impulse Wheel Company, New York, has just secured the contract for the water wheels and hydraulic machinery of the Utah County Light & Power Company. The electrical apparatus will be supplied by the General Electric Company. The water wheels and generators are of the latest type, and this is going to be a model plant. The

engineer in charge is Mr. F. R. Haywood. The American Impulse Wheel Company is making rapid strides in the placing of its high grade water wheels, and is recognized by the best engineers in the country as having a very high efficiency wheel, and one of exceedingly good mechanical construction.

FALCON FAN MOTORS.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has just issued Bulletin No. 5, relating to Falcon fan motors. These machines are made for direct-current, and embody several desirable features. The universal joint permits of their use as desk fans or bracket fans, without adding or changing parts. These motors are manufactured for 12-in. and 16-in. fans, for 100 volts to 125 volts, 200 volts to 250 volts, and battery circuits. The company is also making two sizes of direct-current power motors—1-12 horse-power and ⅛ horse-power—wound as series and shunt motors for 100 volts to 125 volts, 200 volts to 230 volts, and for battery circuits.

TAYLOR SLEEVE-GATE TURBINES.—The works of the Taylor Manufacturing Company, makers of the Taylor Sleeve-Gate Turbine Water Wheel, at Lynchburg, Va., are situated on three great railroad trunk lines leading North, South, East and West. Moreover, the company enjoys equally as good freight rates to all points in the United States as can be obtained by the most favored competitors. In the manufacture of its machinery it has the cream of American pig iron from the Virginia mines and is in close touch with the steel market; it enjoys, besides the advantages of cheap coal and coke, the best climate on the earth and excellent labor. The example of this company in establishing its works in the South is significant in view of the steadily rising industrial development of that section of the United States.

LEA ELECTRIC MANUFACTURING COMPANY.—The Lea Manufacturing Company, manufacturers of the Lea enclosed arc lamps, and the Robinson Electric Heater Company, owners of the Robinson electric heating apparatus and rheostats, have been absorbed by the Lea Electric Manufacturing Company, of Elwood, Ind. The new company will increase its shop facilities, so as to be able to keep up with the greatly increasing demand for the Lea arc lamp. It will put on the market a line of heating devices, rheostats and special resistances of a very novel character and using a new resisting material. Mr. Mortimer Levering, of Lafayette, Ind., is president; Jacob Loomis, of Elwood, Ind., is vice president and general manager; Conway Robinson, formerly of Baltimore, Md. is assistant manager and engineer, and H. H. Thacker, of Elwood, Ind., is secretary.

INTERIOR CONDUITS.—The flexible metallic-armored conduits for carrying electric light and telephone wires in the interior of buildings made by the Sprague Electric Company is growing in favor constantly. The board of underwriters indorses it for all exposed wiring, and for buildings already constructed in which wiring is to be done. Improvements have been made in attachment applications to rosettes, sockets, etc., which are set forth in a bulletin which will be sent upon application. The Lundell motor for 15-in. and 18-in. fans are new sizes this season, and are proving very popular, the 18-in. fan in many cases taking the place of a more expensive blower. The Sprague Electric Company is also making a new ceiling fan, known as the "Colonial," which is selling very well. It is a four-blade fan of nice appearance, which can be sold at a comparatively low price, and which will stand constant use.

THE BICKFORD DRILL & TOOL COMPANY, Cincinnati, Ohio, in its latest catalogue, adopts the principle that as catalogues are usually filed under either the firm name or the line of product they represent, the cover should refer to but these two things. The reading matter is made to present a well-balanced appearance, by having each succeeding paragraph, so far as possible, made a little longer than the preceding one. The final pages answer a double purpose—supplying a code and an index as well. The code words begin with a different letter for each size of radial and change their second letter with each style. In the Table of Amounts a method is adopted to designate the exact combination wanted in ordering a multiple drill. The machines, besides being grouped according to size, are arranged alphabetically according to their code words, thereby doing away with the necessity of first looking through the index.

THE CUTLER-HAMMER COMPANY'S NEW QUARTERS.—It is reported that the Cutler-Hammer Manufacturing Company has quadrupled its business in its new Milwaukee plant. It has there 45,000 square feet of floor space, or three times more than it had in Chicago, and brought with it from Chicago 80 employees. It has increased its force from about 125 to 175, and will soon have 300; increased its capital stock from $100,000 to $150,000 six weeks ago, and has, says President Frank R. Bacon, every reason to feel that the change of location from Chicago to Milwaukee was a wise one. Part of the new equipment being put in by the company consists of a 100-hp engine. Of the $150,000 now invested in the Cutler-Hammer works none is held by anyone but the officers of the company. F. L. Pierce is the vice-president of the company; H. H. Cutler, general manager; J. G. Hickcox, secretary and treasurer, and F. W. Smith, superintendent.

KENDRICK & DAVIS.—Mr. A. Kent, of Worcester, Mass., who was the manager and owner of the Kent Electric Company, manufacturers of the Kent motors, has moved his business to Lebanon, N. H., and will hereafter be associated with Kendrick & Davis, the latter having absorbed the Kent Electric Company. Kendrick & Davis have for years manufactured the well known Porter motors, one of the pioneer battery motors. The firm has extensive manufacturing facilities and operate their factory, the year around, by water power, being located on the Nashua River, at Lebanon, N. H., where water is abundant. This company, besides manufacturing battery fan motors of all kinds as well as small motors for various other purposes, manufacture voltmeters, ammeters, medical batteries, coils and many other electrical novelties. They are also soon to place on the market an entirely new gas engine igniter, which will embody many new features from any of those on the market at the present time. Mr. Kendrick states that they are shipping large quantities of goods to China, London, Paris and Cuba.

A PROSPEROUS TELEPHONE MANUFACTURING COMPANY.—The experience of the Schmidt & Bruckner Electric Company has been one of continuous expansion since it began the manufacture of telephone apparatus, over three years ago. From a small beginning its business has extended, and now it ranks among the largest of the telephone manufacturers of this country. It has enlarged its quarters several times, eventually outgrowing its facilities in each instance. In order to fill the large number of orders now on hand and to provide sufficient facilities for increasing its factory output in the future without the necessity of moving, the company has purchased a large plot of ground at Weehawken, N. J., and erected a substantial building with a complete equipment of the latest machinery. Its general offices are now located at 325 Broadway, New York City, where it also has a storeroom with a large stock of complete telephones ready for quick shipment. A fine exhibit of its goods is also shown in the same building. The Schmidt & Bruckner Electric Company invites its friends to call at the new quarters.

THE KENTUCKY ELECTRICAL COMPANY, Owensboro, Ky., manufacturer of incandescent lamps, has planned to double its output capacity in the season of 1900 and 1901. The entire output of the present factory has been practically contracted for. The company has just increased its capital stock from $25,000 to $50,000 for the purpose of making these improvements, and in order to meet the continually increasing demand for its lamp. As noted in a recent issue, the company also contemplates the addition of a dynamo and motor department to its business, for the manufacture of direct current motors and dynamos in small units. The company's trade extends in almost every southern state, as well as in some of the northern states. Its lamps are said to be of the highest grade that can be made from the best materials and by the aid of modern machinery. Kentucky lamps are made individually from beginning to end, both in the treatment of the filaments and in the exhaustion, thereby insuring a uniformity of detail. This is the first incandescent lamp factory established in the South. It was started last August and is running to its full capacity, and the success enjoyed by the company is attributed to the fact that nothing has been left undone that would in any way contribute toward the production of first class goods.

THE AMERICAN ELECTRICAL & MAINTENANCE COMPANY now occupies new quarters at 122-130 Centre Street. For some time this company has realized that their old location at 451-453 Greenwich Street was not convenient for the majority of their customers or themselves, and their rapidly increasing business demanded that a change be made. Being now situated in the heart of the manufacturing and hardware business, they are enabled to turn out their work more quickly and less expensively, and this fact has already been appreciated by several of their clients. The business of this company is comprised chiefly of electrical repair and construction work, and among their best customers they number several of the largest and most prominent electrical manufacturing companies. For the convenience of those doing business with this company, they keep on hand a large quantity of electrical supplies of all kinds, and can furnish promptly anything required, from a lamp socket to a dynamo or engine, including the various wearing parts of all systems of elevators, controllers, dynamos, motors, etc. Perhaps the most interesting feature of their business to the general public, is the system of maintenance contracts, by which are guaranteed the successful operation of an electrical plant, for a fixed annual premium, the entire expense of any and all repairs being assumed, including renewal of parts, which become necessary within the year.

MINERAL WOOL IN SOUND BUILDING CONSTRUCTION.—In all buildings, hollow vertical flues and open spaces in walls or partitions should be completely closed and filled, either with brick and cement or some non-conducting, non-burning material, such, for instance, as mineral wool. The cheapest thing to do—and it should always be done—is to cut off all manner of communication by hollow passages from one story to the next above by so-called "fire-stop," consisting in rows of bricks laid in mortar and filling completely the whole space from the outside of the wall to the interior finish of wainscoting or baseboards. Additional safety may be gained by substituting for the ordinary lathing, stout wire lathing, or netting. Hollow spaces between floor-boards and the lathing and plastering of ceilings, form a hollow space for vermin, accumulate dirt and dust, and are generally objectionable, not merely from a sanitary point of view, but principally on account of the increased danger in case of fire. All horizontal spaces between floor joists should be closed by completely filling in from the sill or girders, upon which the floor joists rest, to the wall, with concrete plaster or brickwork. The details of improved building construction just described should form a part of the builder's specifications for all classes of buildings. Among the materials most suitable to accomplish the above is Mineral Wool, which, on account of its fluffy nature, is peculiarly adapted for the purpose, and especially because of its being fireproof, and easily applied.

A HANDSOME CATALOGUE.—The National Conduit & Cable Company, New York, recently brought out a catalogue of its products that is deservedly entitled to first rank in the art of catalogue making. It is 8½ ins. x 11 ins. in size and has a handsome embossed cover. The book opens with a fine view of the company's works at Hastings-on-the-Hudson, and this is followed by a brief history of the company. The illustrations are of the highest order, those showing sections of the various sizes and styles of cable being particularly artistic. The latter are shown in actual size in colors to correspond with those of the materials represented. Thus the solid, multiple and stranded cores are in copper bronze, the insulation is brown and the sheathing is silvered to represent the lead covering. Sets of specifications for the installation of cables, and for supplying ducts and constructing a complete electrical subway are bound in and form a part of the catalogue. Besides the illustrations above mentioned are many others, half-tones and diagrams, representing joints of all kinds, terminals, service boxes, and all of the component parts of the complete system of underground work. The colored views of cable samples represent cables in actual use throughout the country in telephone, electric light and railway work, and some English railway cables. The construction of manholes, and actual underground work are also very completely and clearly illustrated, and altogether the catalogue is one of exceptional artistic merit, besides being of great practical value. Apart from the illustrations there is much valuable text matter on the subject of cables—insulation, manufacture, etc. The catalogue besides being of great value to those interested in this line of work, is a thing of beauty, and in its production the National Company has established a standard that will be difficult to surpass.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED APRIL 24, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

647,932. ELECTROMAGNETICALLY OPERATED RAILWAY SWITCH; F. E. Baldwin, New York, N. Y. App. filed Dec. 12, 1899. A vertical tel escoping rod stands between two magnets and rests against the underside of the switch tongue. A spring interposed between the parts of the rod normally lifts the tongue slightly and therefore makes the work of the magnet lighter. The passage of a car over the tongue presses it down until it is supported by the rail.

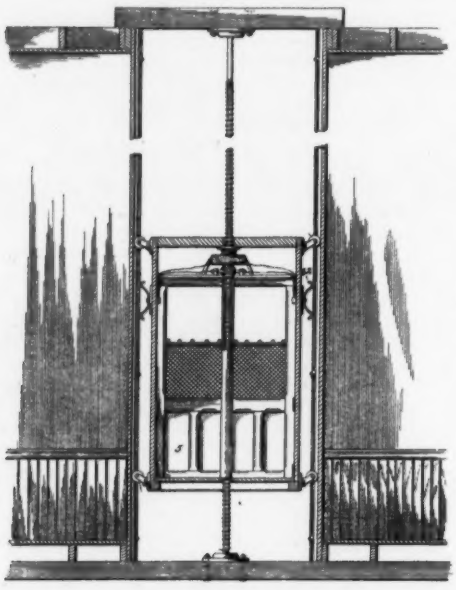
647,940. SYSTEM OF TRAIN CONTROL; H. W. Buck, Schenectady, N. Y. App. filed Feb. 1, 1899. (See Current News and Notes.)

647,945. SUPPORT FOR ELECTRIC CONDUCTOR; T. J. Cope, Philadelphia, Pa. App. filed Feb 2, 1900. This device is particularly used for supporting wires and cables in a subway, and consists of a bracket arm removably connected with a vertical support, and receives the cables in seats formed on its upper edge. The bracket can be removed without disturbing the wires.

647,960. ELECTROLYTIC CELL; G. W. Gessener, New York, N. Y. App. filed Dec. 15, 1899. The cathode of the cell is an alloy of iron and hydrogen, the hydrogen being present in such quantity as to prevent oxidizing action, including that arising from chlorin.

647,970. APPARATUS FOR INDICATING LEAKAGE OF CURRENT FROM ELECTRIC CONDUCTORS; M. Kallmann, Berlin, Germany. App. filed Dec. 27, 1898. (See Current News and Notes.)

647,980. ELECTRIC ELEVATOR; J. F. Morrison and O. M. Woodrow, Wellston, Ohio. App. filed April 10, 1899. The armature of an electric motor placed on the car acts as a nut, upon a screw shaft extending vertically through the elevator way. The rotation of the armature causes the car to travel up or down upon the threaded shaft. The invention consists of the details of construction.

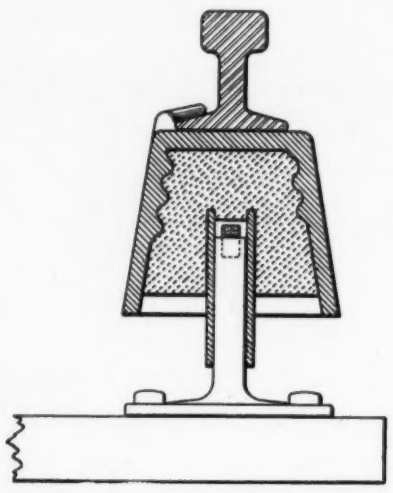


647,980.—Electric Elevator.

648,009. MAXIMUM METER; H. O. Westendorp, Saugus, Mass. App. filed Feb. 28, 1900. (See Current News and Notes.)

648,052. BRUSH HOLDER; E. B. Priest, Schenectady, N. Y. App. filed Jan. 27, 1900. Details of construction.

648,057. THIRD-RAIL INSULATOR; E. W. Rice, Jr., Schenectady, N. Y. App. filed Feb. 20, 1900. The insulator is constructed to rise and fall slightly under strain.



648,057.—Third-Rail Insulator.

648,081. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. The bond is held in contact with the rail constantly by spring pressure and is not secured by bolts or rivets as usual.

648,082. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. The bond is applied to the end of adjacent rails at the bottom thereof and constitutes at the same time a seat for the rails.

648,083. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. This bond is placed beneath the rails and consists of separate flexibly supported contact pieces joined by a flexible conductor.

648,084. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. The fish plates are connected with the rails by a copper bond, which is held in contact with each of them by spring pressure.

648,085. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. A spring contact bond is located between the fish plate and the rail.

648,086. ELECTRIC RAIL BOND; C. F. DeRedon, New York, N. Y. App. filed Aug. 24, 1899. The bonding conductor spans the fish plates and is held in contact with the rails at each end by springs.

648,092. ELECTROMAGNETIC ELECTRIC RAILWAY TRACK SWITCH; P. B. Williams, Washington, D. C. App. filed Oct. 5, 1899. Circuit details.

648,106. DENTAL ENGINE; H. W. Heinz, Pittsburg, Pa. App. filed Feb. 11, 1899. This invention consists in certain frictional gearing whereby the motor can be reversed at full speed without jarring the machine.

648,118. COMMUTATOR; H. F. Stubenrauch, Chicago, Ill. App. filed Feb. 6, 1900. A commutator composed of disk-like sections, each having a body portion of insulating material, divided to form separable parts, and segments secured to the periphery of the body portion.

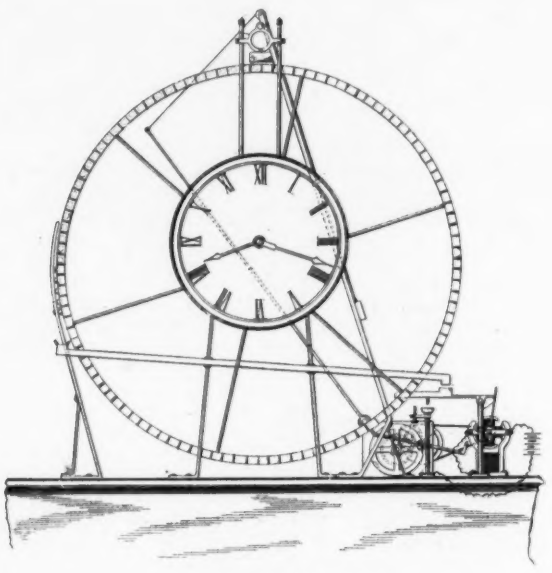
648,119. PROCESS OF MANUFACTURING RICH FERROCHROMIUM; E. Vielhomme, Froges, France. App. filed July 25, 1899. (See Current News and Notes.)

648,141. INOXIDIZABLE CORRUGATED BLADE OR PLATE; A. Belmont, Paris, France. App. filed July 26, 1899. This is an electrode for accumulators consisting of two parts, one of which is oxidizable and the other inoxidizable, the former is provided with hooks engaging with the edge of the latter for purposes of support.

648,144. ELECTRIC LIGHTING APPARATUS; R. M. Chamberlain, Depew, N. Y. App. filed Nov. 20, 1899. The principal object of this invention is to provide convenient means for reversing by hand the relative working conditions of two sets of batteries and to open the main circuits between the batteries and the generating apparatus and connect at the same time both batteries in multiple directly with the lighting-circuit in case of any disarrangement of the generating apparatus.

648,171. DOOR RELEASER; B. F. Latin, Clayton, Mass. App. filed March 2, 1899. The circuit controlling the door releaser of a fire-engine house leads to the seat of one of the vehicles, where it is connected by a detachable coupling with circuit controllers on the vehicle, thus putting the control of the door into the hands of the driver.

648,174. INSULATING COUPLING DEVICE; O. W. Meyrowitz, New Rochelle, N. Y. App. filed Feb. 27, 1900. Details of construction of a coupling designed more particularly for dentists' and surgeons' use in connection with an electric motor, the object being to insulate the current from the flexible shaft used for rotating a tool.



648,296.—Electric Clock.

648,252. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; M. Garl, Akron, Ohio. App. filed Nov. 29, 1899. Telephone circuits between the block stations are closed by the presence of a train on the block.

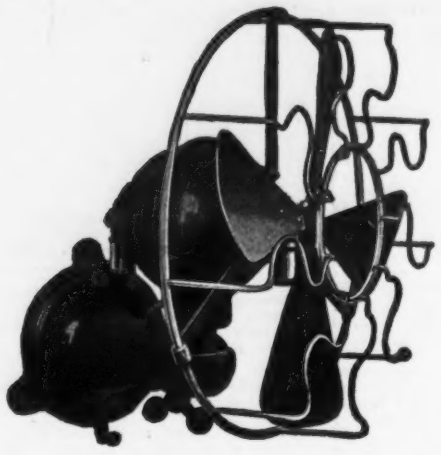
648,274. CONTROLLER SWITCH; C. A. Lindstrom, Chicago, Ill. App. filed Feb. 8, 1900. The object is to insure the simultaneous movement of the blades of the several switches employed to switch the current to obtain the first, second and third speeds of the vehicle, and the invention consists of the details of a switch for this purpose.

648,295. ELECTRIC ARC LAMP; W. E. Pugsley, Lincoln, Neb. App. filed Sept. 29, 1899. Details.

648,296. ELECTRIC CLOCK; P. M. Ravenskilde, Cabery, Ill. App. filed April 7, 1899. In this clock the time train is propelled by weight balls fitting in the periphery of a wheel. The balls ars discharged periodically from the lower part of the wheel and lifted to the upper part by an electric motor.

648,367. FIRE ALARM SYSTEM AND APPARATUS; R. A. Smith, Norfolk, Va. App. filed Aug. 31, 1899. A series of loops extending out from a central station and containing signal-sending and signal-receiving devices, a local circuit and responsive devices therein at the central office under the control of all the loops, a second local circuit and a series of relays included therein controlling contacts in the various loops, and means whereby the responsive devices in the first local circuit may control the second local circuit.

A Word About Fans.



Since their introduction, the manufacture of electric fans has increased remarkably. They are both a luxury and a necessity, and the question now is not, shall we have electric fans? but, which electric fans shall we have? The wise man knows that the best is the cheapest even though it costs a little more in the beginning, and he straightway buys the Lundell. Why? Because there can be but one correct principle of design and construction. The Lundell fans were the first and only electric fans made on the correct principle and that are covered by patents, so that the Lundell is still the standard, and ever will be.

The purchaser of a Lundell fan has the satisfaction of knowing that he has the best fan ever made and one that is durable, and that he will not soon have to buy another or be obliged to pay frequent bills for repairs.

The sizes of the Portable and Bracket types this season are 12, 15, 16 and 18 inches. We also have column and ceiling fans of various styles. In fact, we can supply fans suited for any condition.

Users should see that the name Lundell is stamped on every fan motor base, and dealers who want quick sales and satisfied customers should sell the Lundell fans.

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General Offices: 527-531 West 34th St., New York.

CHICAGO OFFICE: FISHER BUILDING

BOSTON OFFICE: 275 DEVONSHIRE STREET.

Diehl Electric Fans.

Our Ceiling and Electrolier Fan Patents sustained by U. S. Court. Use or sale of infringements stopped by injunction.

Highest Efficiency.

For all Currents except Alternating.

Ceiling Fans.

Electrolier Fans.

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Perfect in Mechanical and Electrical Construction.

Desk Fans.

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Also builders of Direct-Current Dynamos and Motors.

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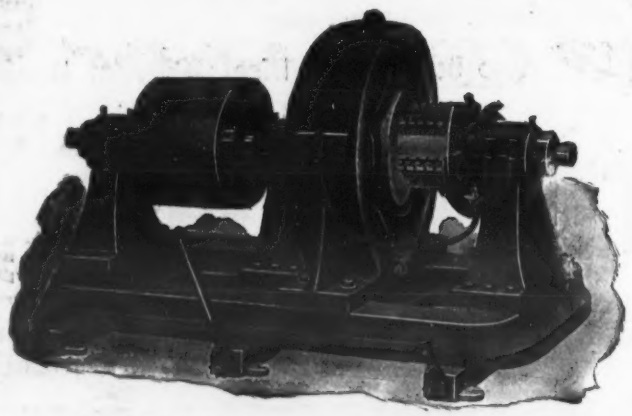

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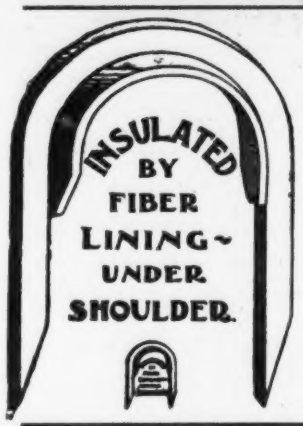

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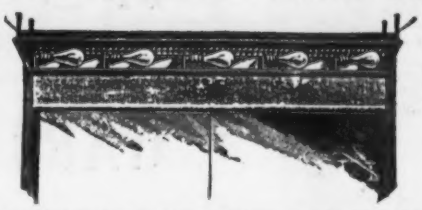

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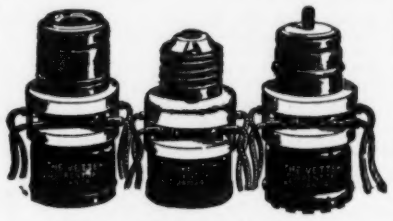

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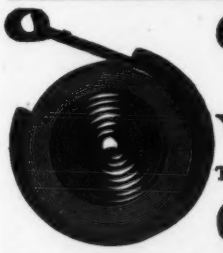

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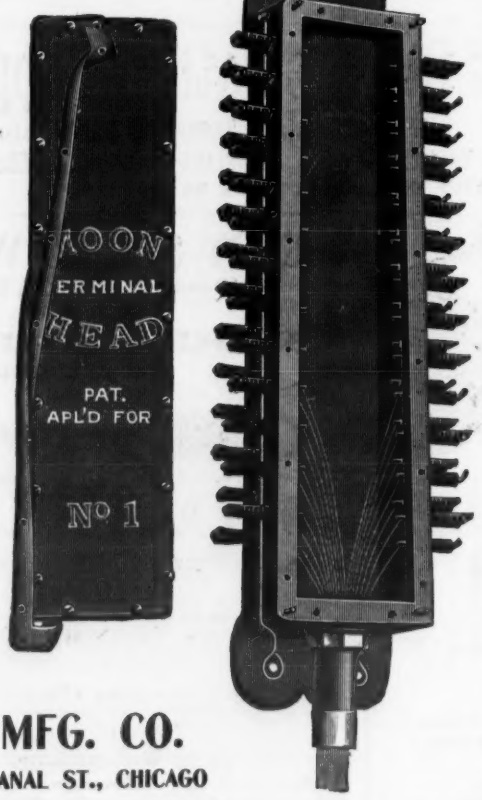

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